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Editorial: Contradiction is not argument

Robert Marks

Editor

"Argument isn't the same as contradiction. An argument is a collected series of statements intended to establish a definite proposition. It isn't just contradiction. Look, if I argue with you, I must take a contrary position. But it isn't just saying, 'No, it isn't.' Argument is an intellectual process; contradiction is just the automatic gainsaying of any statement the other person makes." From *Monty Python's Flying Circus*, The Argument Clinic, BBC-TV, 2 November 1972.[1]

The CSIRO and the Coalition (and News Corp.) have been engaged in a continuing disagreement about the costs of future power for Australia: which is cheaper — renewables or nuclear? Is this a suitable case for a Point Counterpoint debate in the pages of the *Journal*? For this engineer-turned-economist (and a one-time beneficiary and employee of the CSIRO), it doesn't seem so, because one side (CSIRO and the Australian Energy Market Operator, AEMO) is listening to the other and adjusting its estimates of the cost of renewables;[2] but the other side (Peter Dutton's Coalition) just repeats its mantra that "nuclear is cheaper." That is, it contradicts the CSIRO, but doesn't engage in argument. And it conveniently overlooks the issue of time to delivery.

At a recent Zoom meeting of the Editorial Board of the *Journal*, there was general agreement that including written interactions between parties who disagree can be very interesting for readers and even historically valuable. The *Journal* has done this, once: in the December 2020 issue, we included seven pieces around the topic of natural gas as a "transition" fuel on the de-carbonising path to a renewable future.[3] The participants were current and past Chief Scientists of Australia, three FRSNs, a member of the Chief Scientist's Advisory Group, an ANU engineering professor, and a physicist from Arizona State University. I called it "*Point Counterpoint*: Gas as a Transitional Fuel." None of the parties denied global warming; the issue was rather how to transition. Such debates, properly and respectfully curated, could be of great value and interest to readers of the *Journal*, we agreed.

The question remains how to create or find such constructive disagreements. Another Point Counterpoint would require serious disagreement but also argument by established authorities. Such conditions or situations are not readily or frequently experienced. I do not believe that the political disagreement over renewables versus nuclear — significant through the stakes are — meets the prerequisites for a PCP.

This issue contains a section on the book launch for the history of the Royal Society (from the mid-nineteenth century to the

1 https://www.youtube.com/watch?v=uLlv_aZjHXc

2 https://www.csiro.au/en/research/technology-space/energy/GenCost

3 "*Point Counterpoint*: Gas as a Transitional Fuel," *Journal & Proceedings of the Royal Society of NSW*, 153: 180–204, 2020. https://www.royalsoc.org.au/v153-2/

beginning of the First World War), by Anne Coote. In *Knowledge for a Nation: Origins of the Royal Society of New South Wales*, Dr Coote establishes pretty conclusively that the Society is directly descended from the Australian (Philosophical) Society of 1850, which became the Philosophical Society of NSW in 1856, and finally the Royal Society of NSW from 1867. Her Excellency, the Governor, refers in her Introduction to the vice-regal role of her predecessors in the Society's foundation. In particular, she highlights the role of Sir William Denison (Governor from 1855 to 1861), who was an engineer and scientist. The emergence of the 1856 Society was largely due to the arrival in Sydney of Sir William. We have included an image of him in the introduction to the Book Launch section, courtesy of Government House, Sydney, where his portrait hangs. His first address to the new Society (on 9th May 1856) was on railways, and their impacts on business and society.

But it was Sir William's interest in science (he was a conchologist as well as an engineer) that excited interest among local journalists in the fifth estate, who were sufficiently excited to write a piece which worried about the new Governor spending too much of his time and energy on his scientific pursuits, at the expense of activities — building roads, railways, bridges, wharves and harbours, and other noble civil-engineering projects — necessary for the Colony. One newspaper published a satirical article about a meeting of the fictitious "Royal Society" — remember, this was 12 years before the Royal Charter — which mocked fictional scientific engagement.

To give a flavour of the article:[4]

> Royal Society of N.S.W. This learned body met this year in the large hall of the Australian Museum, when after an excursion to the site of some Botany Bay or other remains, and an investigation into the nature and quality of the beer of the natives, Professor Swell read a paper on 'London Gin.' The illustrious Professor considered that sold at two and sixpence a bottle: preferable, when a friend had to pay for it; that at two shillings he found sufficiently pure and strong, in cases when he himself had to act as the purchaser. London Gin was divided into different species, of which the poetical 'cream of the walley [sic],' for the use of bards, and the more familiar 'Old Tom,' for mixing in general society were the best known. Gin contained turpentine to a large extent; and such was the inflammable nature of it, that it would be a really interesting experiment to ascertain whether a gentleman placing the lighted end of a cigar to his mouth after imbibing alarming quantities of the liquor in question, would not at once take fire … The remainder of the day was devoted to an animated conversation on certain Colonial cherries, which grew with their stones outside;[5] and some interesting experiments as to the amount of liquids and solids really containable in the human stomach.
>
> And so on.

Was it the Society which excited such a reaction? More probably it was the new Governor. Anyway, Fort Denison in the Harbour reminds us that he did not neglect the task

4 See "Denison and Science." *Bell's Life in Sydney*, Feb. 3, 1855, p. 2. https://trove.nla.gov.au/newspaper/article/59759779

5 Probably *Exocarpos cupressiformis* (Santalaceae)

of improving the Colony's infrastructure. I am indebted to the current Governor, H.E. Margaret Beazley, for drawing our attention to the article and providing the portrait of Sir William, which has not, as far as I am aware, been published online previously.

The publication of a new history of the Society might not always excite great interest, but Anne Coote has gone to some lengths to mine the archives, focussing on the personalities of the members, their agreements and disagreements, and the consequences for New South Wales over sixty years. This makes for fascinating reading. The book is available from the RSNSW online shop[6] at $50 for RSNSW members, or John Reed Books ($59.95).

The December issue of the *Journal* contains eight papers, nine PhD abstracts, and the 2024 Proceedings (Awards, Events, and newly gazetted FRSNs). A measure of our advance in use of solar energy as a renewable energy source is the efficiency of solar cells to convert sunlight into electricity. Green (2022)[7] reported a solar cell efficiency of 26.8% in October 2022, which is over twice the efficiency seen in plant photosynthesis. The first paper, by Herdean, presents an exploration of the biofeedback photobioreactor concept, delving into the technological paths that might lead to such a breakthrough in the study of and applications with photosynthetic microorganisms. The second paper is a biographical portrait of the nineteenth-century amateur Sydney astronomer, George Denton Hirst (1846–1915), by Nick Lomb, one-time curator of the Sydney Observatory, Wayne Orchiston and Andrew Jacob.

The Book Launch section includes, as indicated above, a welcome by the Society's Patron, Her Excellency the Honourable Margaret Beazley; the official launch by the State Librarian, Dr Caroline Butler-Bowdon; the Foreword to the book, written by the Society's current President, Dr Susan Pond; a few words by the author, historian Dr Anne Coote; and an enthusiastic review of the book by the Society's current Vice President, Dr Peter Shergold.

Following the Book Launch are four papers which derive from presentations made at monthly meetings of the Society. In February, John Bell spoke on "Shakespeare on politics: what can we learn?" The paper derived from the talk reproduces the only surviving example of Shakespeare's hand. I note that the results of the U.S. presidential election make this quite timely.

Roy Green and Ken Henry gave talks to the Society several months apart. Green's talk was about productivity, and possible reasons for Australia's slow growth of labour productivity, which in turn results in slow wages growth, compared to other advanced economies. The topic is related to inequality in society, the topic of Ken Henry's talk in late 2024, in which he explored revising Australia's tax regime and other issues.

Federal Parliament has enacted a law (a world first, in apparent response to concern about the state of mental health of young people) which will ban under-16s from accessing some social media. Several months earlier, the Australian eSafety Com-

6 https://members.royalsoc.org.au/rsnsw-shop/

7 Green M.A. (2022) Silicon solar cells to power the future, *Journal & Proceedings of the Royal Society of NSW*, 155, 168–181.

missioner, Julie Inman Grant, had addressed the Society on the broad topic of the internet, and how its initial promise[8] has been blighted by the behaviour of users of social media, inter alia. What are the possible remedies? Her paper has proved very timely.

In 2023 we republished a paper by Jim Falk et al.[9] on the hydrological impacts of climate change. Now we republish another paper by Falk et al. on the impacts of climate change on the world's oceans, following COP-29. Despite the opinions of some, I believe that climate change is the most serious issue that humanity faces in late 2024.

Housekeeping

At Council's suggestion, the Editorial Board of the *Journal* was expanded to twelve by including three new members: Pamela Griffith FRSN; Helen Irving FRSN; and Toner Stevenson. A Zoom meeting of the Editorial Board was held on 4 December.

A revised version of the *Journal*'s style guide and Information for Authors will be released in the coming months. The current edition was published in May 2017.

I wish to thank Jason Antony MRSN and Rory McGuire for their assistance in producing this issue of the *Journal*. I also thank members of the Editorial Board for their suggestions for improving this Editorial. Lindsay Botten FRSN, web-master extraordinaire, helped to upload it to the Society's web pages. Indeed, Lindsay should be thanked for his efforts in a smooth transition of all the Society's web pages to a new architecture, WordPress. This transfer means that the URLs of recent *Journal* articles have changed. The new URLs are to be found on the *Journal* Archive.[10]

Balmain
12 December 2024

8 My first recorded interaction on the internet was Marks, R.E. (1986) Easy-to-learn, WYSIWYG, technical word processors? net.text, June 5, archived at https://groups.google.com/forum/#!topic/net.text/rvi_FPmQBTE

9 Jim Falk et al. (2023), Critical hydrologic impacts from climate change: addressing an urgent global need. *Journal & Proceedings of the Royal Society of NSW*, 156: 291–297.

10 https://www.royalsoc.org.au/society-publications/the-royal-society-of-nsw-journal/journal-archive/

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Advancements in biofeedback photobioreactors: using the language of light deciphered from the organisms themselves

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Abstract

This paper presents an innovative exploration of biofeedback photobioreactors, which utilise the "language of light" decoded from photosynthetic organisms themselves. Addressing the inherent inefficiencies in photosynthetic conversion under various environmental conditions, the study delves into the potential of optimising abiotic factors in such systems. The core principle involves chlorophyll *a* fluorescence as a real-time indicator of photosynthetic activity, offering a non-invasive, comprehensive communication method between the researcher and the microorganism. By integrating this approach with advanced machine learning techniques, the paper proposes a method for deconvoluting complex fluorescence signals unique to each species. This approach not only holds the promise of enhancing the efficiency of photosynthetic microorganisms in controlled environments like bioreactors but also paves the way for significant advancements in sustainable biofuel production and other biotechnological applications. The paper underscores the importance of interdisciplinary research in overcoming the challenges of photosynthetic efficiency and highlights the potential of biofeedback photobioreactors to revolutionise the field of algal biotechnology.

Introduction

Photosynthesis, the fundamental process by which plants, algae, and some bacteria convert light energy into chemical energy, has immense implications for both natural ecosystems and human industries. Despite its critical role, the efficiency of photosynthetic conversion, particularly under varying environmental conditions, remains suboptimal (Falkowski et al., 2017; Lin et al., 2016; Melis, 2009). On a global scale, phytoplankton convert approximately 35% of absorbed photons to chemical energy through photosynthesis, while the majority, about 60%, are dissipated as heat, indicating a relatively low efficiency of photosynthetic conversion (Lin et al., 2016). Furthermore, under ideal conditions, the maximum efficiency of plant photosynthesis in sunlight is 13%, however, when accounting for real-world factors such as measured quantum yields and absorption factors, the efficiency estimate drops to 9.3%, highlighting the intrinsic limitations and suboptimal efficiency of photosynthesis in natural conditions (Bolton and Hall, 1991). This inefficiency works well in natural environments but poses a significant challenge in controlled environments, such as bioreactors used in biotechnological applications.

The advent of biofeedback photobioreactors presents a promising solution to optimise biotic and abiotic factors that impact photosynthetic microorganisms. Optimisation of light utilisation via biofeedback has been demonstrated in higher plants (Ahlman et al., 2017; Van Iersel et al., 2016) but to date this research has not been translated in the microalgal research community. By integrating a feedback loop

between the photosynthetic organism and the light source, these systems promise a more efficient energy conversion process. The adoption of such technology could herald a significant leap forward in enhancing energy use efficiency and yield, with broad implications for sustainable production of biofuel (Brennan and Owende, 2010; Hoang et al., 2023; Peng et al., 2020; Rafa et al., 2021), pharmaceuticals (Lu et al., 2024), human consumption (Yang et al., 2024), nutraceuticals (Nicoletti, 2016), aquaculture feed (Han et al., 2019) and wastewater treatment (Srimongkol et al., 2022). This paper presents an exploration of the biofeedback photobioreactor concept, delving into the technological paths that might lead to such a breakthrough in the study of and applications with photosynthetic microorganisms.

Biofeedback: a two-way conversation

Simply put, the concept of biofeedback is a two-way communication between a microorganism and the researcher. For such a system to work we need to have an effective communication system that allows us to get information from the microorganism (1) in real-time, (2) non-invasively, and (3) the information needs to be complex enough to describe as many internal biological processes as possible.

At the core of this innovative approach is the utilisation of chlorophyll *a* fluorescence as a real-time indicator of the photosynthetic and by extension biological status of the cell. Chlorophyll *a* fluorescence is a key non-invasive indicator of photosynthetic activity, specifically of photosystem II (PSII), and is extensively used in algal and plant research (Papageorgiou and Govindjee, 2004). The principle of chlorophyll *a* fluorescence analysis is based on the fact that light energy absorbed by chlorophyll molecules can have three fates: it can drive photosynthesis (photochemistry), be dissipated as heat, or be re-emitted as light — the latter is chlorophyll *a* fluorescence. These processes are interdependent, meaning an increase in the efficiency of one leads to a decrease in the others. Therefore, by measuring the yield of chlorophyll *a* fluorescence, insights can be gained into changes in the efficiency of photochemistry. The method is responsive enough to provide insight on the impact of environmental variables on the cell, which most commonly include, but are not limited to, light intensity (Herdean et al., 2022), light spectra (Bernát et al., 2021; Herdean et al., 2021), temperature (Herdean et al., 2023; Salleh and McMinn, 2011), pH (Behrendt et al., 2020), and nutrients (Nagi et al., 2023). Furthermore, due to the complex interconnectivity of cellular processes, chlorophyll *a* fluorescence, emitted during photosynthesis, serves as a window into the inner workings the cell that go beyond the chloroplast (Bailleul et al., 2015). Data derived from such measurements will form the communication "language" that the photosynthetic microorganism uses in this two-way conversation.

One may ask at this point: given that the method of communication exists, why are there no biofeedback photobioreactors in use? To appropriately answer this question, there are two challenges with chlorophyll *a* fluorescence that need to be pointed out: first, the signal is complex and arguably not fully understood; it's widely accepted that it provides rich insight into the cell's biology, but we only understand small fractions of that signal. Second, each species has its own unique biological response, which results in a fluorescence signal which, to a large

extent, is unique to that species. While not an easy undertaking, this is actually a solvable problem. It is worth giving some examples of fluorometry data used for optimisation, such as growth temperature (Ranglová et al., 2019), glycogen content (Lakatos et al., 2021), biomass production (Masojídek et al., 2011), and generally as an indicator for nutrient stress (Parkhill et al., 2001). A strategy similar to that used in medical sciences (Sagar et al., 2020) could be applied here. Researchers could utilise supervised machine-learning approaches such as neural networks, random forests, or similar architectures, combined with systematic experimentation. By exposing microorganisms to a wide range of environmental conditions, researchers could record specific fluorescence responses, generating data that could train machine-learning algorithms for more accurate classification. This experimental strategy does not require significant a priori knowledge of the microalgae properties or photo-physiological properties; it requires, however, an additional measurement of cell health which will be used to classify the fluorescence measurements. This approach will provide a "Rosetta stone"-type of deconvolution of the chlorophyll signal, enabling the two-way communication. Partial success has already been shown in using machine-learning to deconvolute the significance of fluorescence data from satellite imagery (Bartold and Kluczek, 2023; Liu et al., 2022) and terrestrial measurements (Rybka et al., 2019). This can be taken a step forward by using a generative adversarial network trained on the experimental data to generate signals that the organisms can likely produce but have not been recorded in the initial dataset (Chen et al., 2022).

Assuming the means of communication are resolved at single-cell level, an additional complication arises: the unavoidable heterogeneity found in a population of cells. Realistically, a biofeedback system will work with asynchronous and heterogeneous cell cultures. This means that at any given time, the population is composed of cells at different stages of development, which will likely make signal deconvolution more difficult. Just as before, this is not an unsolvable problem.

Communication with populations: from 1 to many cells

In advancing the field of biofeedback photobioreactors, a key consideration is the heterogeneity inherent in populations of microalgae. As shown by the elegant use of a microscope fitted with a fluorometer (Trampe et al., 2011), microalgal populations exhibit considerable variation in fluorescence response among individual cells. When scaling-up the measurements, this variability averages out and provides a single signal representing the entire population. More recent research demonstrates the utility of microfluidic photobioreactors in observing and cultivating microalgal cells at the single-cell level — a crucial step in understanding population dynamics (Westerwalbesloh et al., 2019). In this context, the transition from individual-cell analysis to population-level communication presents unique challenges and opportunities. A single cell photobioreactor allows for the controlled cultivation of microalgae, providing a platform where individual cells or small aggregates can be studied in isolation under well-defined conditions. This approach is instrumental in discerning the responses of microalgae at

various developmental stages, and to varying environmental stimuli.

Understanding the nuances of individual cellular responses within a population is critical for developing a comprehensive biofeedback system. The rationale behind it is to clarify how complex signals coming from cells in different biological states will average when measuring the whole population. By integrating the insights gained from such microfluidic photobioreactor studies with machine learning algorithms, researchers can unravel the complex web of intercellular communication and response mechanisms. This integration can lead to the development of sophisticated biofeedback systems that can dynamically adapt to the needs of not just individual cells but entire populations.

The heterogeneity observed in microalgal populations underscores the importance of considering individual cellular states and responses. This knowledge is fundamental for achieving effective two-way communication in biofeedback systems. It enables the prediction and modulation of population behaviour, thereby optimising the overall efficiency of the photobioreactor.

Significance and innovation: redefining biotechnological frontiers

The development of biofeedback photobioreactors when completed will not merely be an incremental advancement but a significant leap in biotechnological innovation. This approach holds the promise of addressing one of the most enduring challenges in photosynthesis research: optimising light energy utilisation in varying environmental conditions in real-time. The significance of this innovation extends beyond academic curiosity, potentially revolutionising industries reliant on photosynthetic organisms, such as biofuel production, pharmaceuticals, and food technology.

Innovatively, this technology leverages the dynamic nature of photosynthesis — a departure from traditional static approaches. The term "dynamic nature" refers specifically to the capacity of biofeedback systems to adaptively respond in real time to variations in photosynthetic activity. This contrasts sharply with "static approaches," which represent conventional methodologies that lack the capability to adjust to immediate changes in cellular responses. The introduction of machine-learning and generative adversarial networks to interpret chlorophyll *a* fluorescence signals represents a novel strategy, enabling a more nuanced understanding and control of the photosynthetic process. This innovation could lead to unprecedented improvements in energy efficiency, reducing operational costs and enhancing sustainability in biotech industries.

Challenges and limitations

The history of biofeedback photobioreactors and optimising photosynthetic efficiency has been marked by several key developments. Initial efforts in this field were primarily focused on understanding the basic principles of light interaction with photosynthetic organisms and the design of photobioreactors for efficient microalgae growth (Ahmad et al., 2021). Over time, researchers have explored various reactor designs and light-management strategies to improve photosynthetic efficiency (Janssen et al., 2003). This has included innovations in reactor configurations and light-distribution methods, reflecting a continuous evolution of the technology. Noteworthy photobioreactor designs include tubular

systems (Molina et al., 2001), flat panel (Slegers et al., 2011), thin-layer cascade (Villaró et al., 2022), revolving algal biofilm (Schaedig et al., 2023), and even hybrid designs that separate the dark and light reactions (Deprá et al., 2019). However, the integration of biofeedback mechanisms to dynamically adjust to the photosynthetic organism's needs, represents a more recent and significant advancement in this area.

The technological challenges in the development of biofeedback photobioreactors for optimising photosynthetic efficiency are multifaceted. They involve complexities in accurately interpreting chlorophyll *a* fluorescence data, which necessitates sophisticated algorithms and sensing technologies. Additionally, designing photobioreactors that can dynamically adjust lighting, temperature, nutrients and other conditions in real time to optimise photosynthesis presents engineering challenges. There are examples with partial success where biofeedback has been experimented with (Ifrim et al., 2013; Melnicki et al., 2013) but without use of machine-learning tools and using a limited number of parameters. The next generation of such systems must be capable of rapidly responding to the changing photosynthetic and biological needs of the organisms, requiring advanced control systems and integration of multiple feedback mechanisms. This necessitates a convergence of biotechnology, sensor technology, and control engineering, each with its own set of technical hurdles.

Potential outcomes and impact: a paradigm shift in photosynthetic efficiency

The proposed biofeedback photobioreactor holds the potential to significantly reduce energy losses in algal photosynthesis, marking a paradigm shift in the industry. This breakthrough approach could lead to unprecedented energy savings and enhanced production predictability in algal biotech. Moreover, it offers a direct method to answer scientific queries about photobiology, using the language of light deciphered from the organisms themselves.

The successful implementation of this technology could revolutionise the field of algal biotechnology, contributing to more sustainable practices. It would set a new standard for photosynthetic efficiency, potentially impacting a wide range of applications, from biofuel production to pharmaceuticals. The project's interdisciplinary nature could also pave the way for novel research methodologies, fostering advances across various scientific disciplines.

Conclusion: forging a new path in photosynthetic research and biotechnology

The development of the proposed technology would represent a significant leap in the fields of photosynthetic research, algal biotechnology, and data analytics. This approach not only promises enhanced efficiency in energy conversion but also sets a new benchmark for sustainable and predictable production systems. It underscores the importance of interdisciplinary collaboration and innovation in overcoming historical challenges in photobiology. As we stand at the cusp of this technological revolution, it is imperative to continue exploring and refining these novel methodologies, potentially ushering in a new era of sustainable and efficient biotechnological solutions.

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George Denton Hirst: a remarkable Sydney amateur astronomer

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Abstract

Australian businessman George Denton Hirst was a prominent amateur astronomer for four decades. He was an observer at the 1874 transit of Venus, and he also successfully observed a transit of Mercury in 1894. He observed the planets Mars and Venus and made micrometric measurements of double stars. Thanks to his superb drawing skills, his drawings of Jupiter at opposition brought him to international prominence. Hirst joined a number of scientific societies, starting with the Royal Society of New South Wales, to which he enthusiastically contributed papers in astronomy and in another interest, microscopy. Not only did Hirst contribute papers, but he was always willing to serve on committees, as a member, as a secretary, as chair or as president.

Introduction

George Denton Hirst (1846–1915; Figure 1) was a highly respected amateur astronomer in Sydney during the late 19th and early 20th centuries. He was active in the field for four decades, until his death in 1915. At the time, with few New South Wales professional astronomers, and with little difference between them and the leading amateurs, there was a growing group of local amateurs (see Figure 2), who made serious contributions to astronomy. As well as Hirst, these included the famous Windsor (NSW) astronomer and comet discoverer, John Tebbutt (1834–1916; Orchiston, 2017a); Hirst's longtime friend William John Macdonnell (1842-1910; Orchiston, 2001a); Robert Thorburn Ayton Innes (1861–1933; Orchiston, 2001b), who went on to become a professional astronomer in South Africa; Charles James Merfield (1866–1931; Orchiston, 2015), who also became a professional astronomer, but in Australia; and the comet discoverer Walter Frederick Gale (1865–1945; Wood,

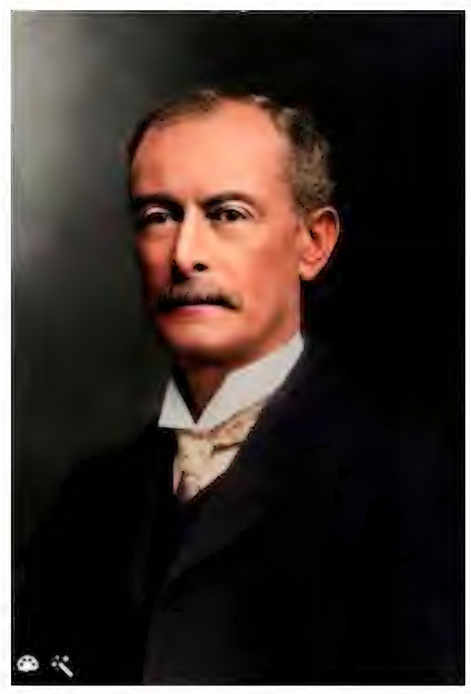

Figure 1: George Denton Hirst in the 1890s. Courtesy Museums Victoria (MM 139568). Colourised image.

1981). As we discuss here, Hirst made a variety of useful astronomical observations, such as observing transits of Venus and Mercury and measuring double stars, but he is best known for his drawing skills, especially when deployed on observations of Mars and Jupiter. He also played a key role in early New South Wales formal astronomical groups. Apart from astronomy, Hirst was also interested in microscopy. There have

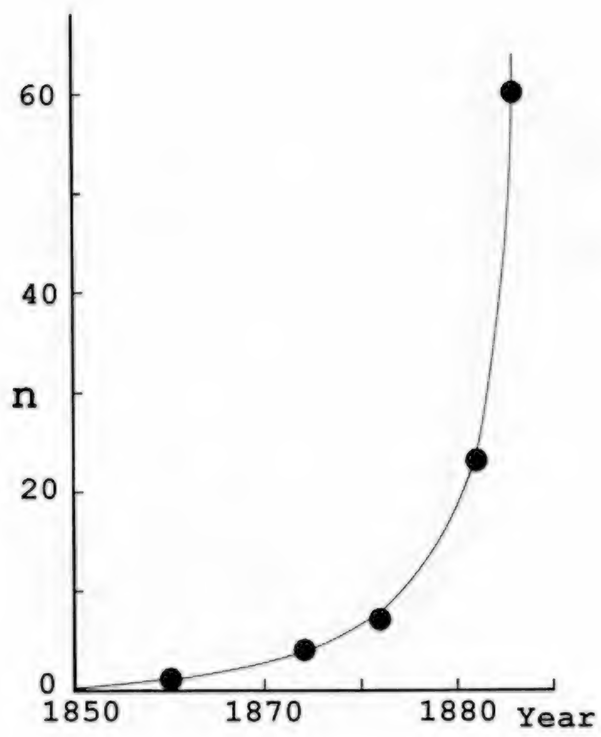

Figure 2: A plot of the number of amateur astronomers in the Sydney-Windsor region between 1850 and 1899, after (Orchiston, 1991a).

been a number of short articles describing Hirst's life (Anonymous, 1916; Holland, 2014; Orchiston, 2017a: 299–300). In this paper, we expand on those brief summaries.

A biographical sketch

Early life and interests

Hirst was born in Sydney on 7 April 1846 and educated at Sydney Grammar School (Jarratt, 1987: 37). He was the son of George Robert Hirst (1820–1874) and Caroline Louise Tucker (1822–1893). Hirst Snr had arrived in Sydney from Yorkshire in 1840 at the age of 19 and worked as a wool buyer for English companies. At age 19, George Denton Hirst was a member of the Voluntary Artillery; at artillery practice he scored a creditable 14 points, as did his younger brother Henry (1847–1903), while the highest score achieved was 20 (Anonymous, 1865). In the following year he was elected to the committee of No 2. Battery Voluntary Artillery (Anonymous, 1866), beginning a lifetime of contributing to organisations by serving on their committees. Such voluntary artillery units were formed in the various Australian colonies to support locally stationed British troops in case of a feared Russian attack. Sailing was also a major interest, with Hirst being part of the crew of the prominent businessman Alfred Fairfax's (1824–1901) locally built yacht *Magic* (Anonymous, 1901). He sailed on the yacht's first race in 1874 and later considered it as a most successful boat with 23 wins out of 32 starts. Fairfax was also a well-known amateur astronomer.

Tucker and Co.

At age 16, Hirst joined the firm of Tucker & Co., wine and spirit merchants, as a junior clerk (Jarratt, 1987: 37). This firm had been founded in 1838 by his mother's brother William Tucker (1814–1888). Soon after Hirst entered the business, William Tucker retired and management of the firm passed to his younger brother James Cawley Tucker (1816–1906), a master mariner. The latter was often away, and Hirst became increasingly important to the firm. In 1895, he was offered the chance to buy shares in the company and become a partner (Jarratt, 1987: 43). The other partner was Hirst's cousin Charles Churchill Tucker (1857–1917), who had a reputation as a sportsman and was only the 877th person to climb the 4806-metre-high Mount Blanc and supposedly the first Australian to do so (Jarratt, 1987: 39). Hirst became an expert on wine and spirits; in 1903, he told a reporter from the *Sydney Morning Herald*:

> By paying a good price you can always depend on getting a pure-grape brandy from several of the leading firms. If you go buying unknown brands of Cognac, however, you will likely receive stuff made in Germany and which never saw Cognac, and more than probable distilled

> from potato peelings or something you might regard as equally objectionable. (Anonymous, 1903)

Until 1908, the firm was located at 379 George Street, Sydney (John Sands Ltd., 1909). This and surrounding buildings were replaced in about 2018 by a massive residential and retail development called York & George (Mladenovski, 2016). The building's ground floor now hosts the Sydney flagship stores of Vodafone and Optus.

Tucker & Co's 150th anniversary book says of Hirst, "He was an unsmiling man, exacting in his requirements of others and intolerant of everything but facts" (Jarratt, 1987: 45) and "[He] thrived on the challenge of extracting order from chaos, of making things run like clockwork" (Jarratt, 1987: 51).

Mosman and later life

In about 1898, George Hirst, together with his wife Mary and two young children, Enid and Harold, moved from Balmain to 28 Muston Street, Mosman (Sands, 1899). The house, named "Berowra," is shown in Figure 3. It is in the Queen Anne Federation style, incorporating elements such as an octagonal mini tower with bay windows, front porch and veranda, fretwork, an asymmetrical design and a complex roof (Ruwolt, 2023).

According to an article in the *Sydney Mail and New South Wales Advertiser*, written five years after the Hirst family move, "A few years ago Mosman was a wilderness … the place has been transformed into one of Sydney's prettiest and most popular marine suburbs" (Anonymous, 1904). The article was written in relation to the bowling green, tennis courts and quoits pitches that the Mosman Recreation Company had recently set up in the suburb. Hirst, with his predilection to contribute was, of course, one of the company's directors.

Figure 3: Hirst in front of his home at 28 Muston Street, Mosman. His daughter Enid is standing at the top of the steps holding a cat, with son Harold and wife Mary on the right. A portable telescope is displayed on the verandah. Courtesy Museums Victoria (MM 137404).

To Hirst, an even more appealing aspect of Mosman would have been that within a few years of moving there he was joined by a good selection of fellow amateur astronomers as neighbours. These included the Reverend Dr Thomas Roseby (1844–1918), Hugh Wright (1868–1957), William Macdonnell (1842–1910), Alan Cobham (1880–1961), Ernest Beattie (1864–1943) and Nathaniel Basnett (d. 1944). All these took part in some capacity in the New South Wales Branch of the British Astronomical Association, as president, vice-president, secretary or as a committee member during the early years of the branch, e.g. (see Orchiston, 1988). Figure 4 shows Hirst with some of his astronomer neighbours.

George Hirst died at home on 20 May 1915 (Anonymous, 1915). The house remained with the family until it was sold in the mid-1970s and was, more recently, demolished to make way for a modern building with two apartments.

Figure 4: Hirst with fellow amateur astronomers at William Macdonnell's Gardonal Observatory, Shadforth Street, Mosman. Macdonnell is standing at the left, behind Hirst, who is seated. Mrs Emily Macdonnell is seated on the right with Nathaniel Basnett seated on the grass in front of her. Courtesy Museums Victoria (MM 137406). Colourised image.

Astronomy

Planetary transits

The 1874 transit of Venus began Hirst's astronomical and scientific flowering and seems to have led to his joining the Royal Society of New South Wales in 1876 (Royal Society of New South Wales, 1876). He was one of a party of observers at Woodford in the Blue Mountains, to the west of Sydney. The Woodford observers were among a number of groups that the NSW Government Astronomer and Sydney Observatory Director, Henry Chamberlain Russell (1836–1907; Figure 5; Bhathal, 1991) had sent out to various places in the colony of New South Wales (Lomb, 2011: 112–131). How Hirst came to be among the Woodford party is unclear. He could have had previously demonstrated

Figure 5: Henry Chamberlain Russell in 1889, (from Anonymous, 1889)

astronomical prowess, or, more likely, it was because he knew the owner of the Woodford property, Alfred Fairfax, through yachting.

Hirst was in charge of the main instrument at Woodford, the 4-inch (10.2-cm) f/15 Dallmeyer photoheliograph, a telescope specially designed to photograph the Sun (Lomb, 2011: 120–121). This was used together with a Janssen apparatus that allowed a series of short-exposure photographs to be taken in rapid succession on a large circular glass plate, (see Launay and Hingley, 2005). This apparatus is also known as a photographic revolver and can be regarded as the forerunner of the movie camera. Both objects still exist and are in the collection of the Powerhouse Museum in Sydney: the photoheliograph is object no. H10211, while the Janssen apparatus is object no. H10213.

After the transit, Hirst described how the photoheliograph was set up with a finder that had a 1.5-inch (38-mm) diameter objective lens and a focal length of 1.22-m (Russell, 1892: 20–21). The lens was used with a Huygens eyepiece and Hirst protected his eye by placing an orange-coloured glass filter between the eyepiece and his eye. He made

a most interesting observation through the finder just as Venus was moving onto the disc of the Sun: Venus was " ... connected to the limb by a narrow line intensely black with an ill-defined edge ... " (Russell, 1892: 20–21). Figure 6 shows Hirst's drawing of what he saw. This was the infamous black drop that had plagued James Cook (1728–1779) and Charles Green (1735–1771) in Tahiti in 1769 (Orchiston, 2017b) and other 18th century observers (Sheehan and Westfall, 2004). It did not appear in photographs and other 1874 observers did not see it through larger, better-quality telescopes. Hirst also glimpsed the black drop during Venus' egress from the solar disc.

Figure 6: Hirst's original drawing of his observation of the black drop effect, drawn for HC Russell's 1892 book, *Observations of the Transit of Venus, 9 December 1874*. Courtesy Museums of History NSW (State Archives Collection A3003, Box 216).

For the 1882 transit, the egress was to be visible soon after sunrise on 7 December from the east coast of Australia. Russell again organized teams of astronomers to observe from various locations in New South Wales. Due to the low altitude of the Sun during the transit, this time he chose high mountains for the observing stations (Anonymous, 1882). Russell sent Hirst to Brothers Hill at Camden Haven, which is 40 km south of Port Macquarie by road. He was fully equipped with instruments, including a 6-inch (15-cm) equatorial by Alvan Clark (1804–1887),[1] another equatorial of 4½-inch (11.4-cm) aperture by William Wray (1829–1885), a portable transit, a chronograph, a clock and chronometers. On Brothers Hill, he was to be joined by William John Macdonnell, who had moved to Port Macquarie earlier that year as the manager of the local branch of the Bank of New South Wales (Orchiston, 2001a). Though Russell chose Brothers Hill for Hirst and Macdonnell, they set up instead on a small hill just outside of Port Macquarie, since known as Transit Hill. The hill provided the necessary unobstructed view towards the east.

In the event, it was cloudy for all the NSW observers (Russell, 1882). Hirst was the only one among them to catch a glimpse of the transit, but it was a short glimpse of only 20 seconds, when Venus was seven-tenths of its diameter off the Sun.

During his stay at Port Macquarie, Hirst had an opportunity to use Macdonnell's own telescope, a 3⅝-inch (9.3-cm) refractor by Parkes and Son of Birmingham, on a night " ... with the extraordinary stillness of the definition ... " (Hirst, 1884). He pointed the telescope at the stars of the Trapezium in the Great Nebula of Orion and managed to see its faint sixth star; both Macdonnell and his wife verified the sighting, with the latter having no prior knowledge of the

1 This telescope was later acquired by the comet discoverer Walter Gale and sold, with an inferior substitute equatorial mounting to the New Plymouth Astronomical Society in New Zealand. There it was installed in their observatory and used extensively for public viewing sessions, (see Orchiston, 1991b).

star's location. This star was either the one known today as E, or the one known as F. Both are 11th magnitude objects and today a 6-inch (15-cm) telescope is recommended for seeing them (King, 2017).

A transit of Mercury took place on 10 November 1894 (Russell, 1895). Hirst observed from his then home at Balmain with a 3¾-inch (9.5-cm) equatorial refractor. He reported to the Government Astronomer, Russell, that he reduced the aperture to 2½-inch (6.3-cm) to stop the coloured glass filter from breaking. As well, he " ... wanted to see if a small aperture had anything to do with the formation of the drop ... ." The black drop did appear, though it was different from the " ... fuzzy, ill-defined stalk connecting the limbs of *Venus* and the Sun ... " that he had seen at Woodford. This time Mercury bulged out towards the edge of the Sun and formed a sharp drop. Hirst concluded that a drop is more likely to be seen through a small aperture. This is correct, but not a complete explanation for the black drop. According to modern analysis, the two main causes are atmospheric seeing and diffraction inside the telescope (Schaefer, 2001). The first indicates that the lower the altitude, the more likely it is that the drop will be seen, while the second indicates that the effect is much greater for telescopes of small aperture.

Hirst sent his Mercury results to Russell, who was pleased with them, as they corroborated his observation of a " ... little unsteadiness ... " in the atmosphere during the transit (Russell, 1894). Russell suggested that Hirst send his results to the Royal Astronomical Society and offered to nominate him as a member. Subsequently, Hirst was elected as a fellow of the Society on 8 March 1895 (Royal Astronomical Society, 1895). Interestingly, that was an eventful time for Hirst, as he had been elected as a member of the British Astronomical Association and its New South Wales Branch just a week earlier (Lomb et al., 2024).

Jupiter

In March 1876, the Royal Astronomical Society (RAS) issued an appeal, addressed particularly to observers in the Southern Hemisphere, to make a careful study of the planet Jupiter (Hirst, 1876). This request was due to the planet's southern declination and hence poor visibility in the UK and other Northern Hemisphere countries. The society wanted drawings of the planet on standardised forms that paid particular attention to " ... the tints and colours of the belts ... ." As well, note was to be taken of the occurrence of small white and black spots.

Hirst saw the appeal at the beginning of May that year and decided to begin observing and drawing Jupiter. He began scientifically by examining all the earlier drawings of Jupiter that he could find in publications. To his surprise, he could only find " ... few and such crude attempts ... " to draw Jupiter. The drawings of some earlier astronomers were " ... said to be remarkably fine drawings, and probably the originals may be; but if this is the case a lithograph copy of one of them that I have seen must be the most woeful libel." (Hirst, 1876).

To make his own observations, Hirst had access to a 10¼-inch (26-cm) aperture silvered glass Browning-With reflector. This belonged to his friend John Ussher Cox Colyer (1846–1910), who lived at Bellevue Hill (Anonymous, 1881) and in 1877 built an observatory for his telescope (Anonymous,

1877).[2] Colyer was a fellow member of the Royal Society of New South Wales, who, like Hirst, was in both Section A, the astronomical section and in the microscopical section of the society.[3] Hirst (1876) mentioned that the telescope had a good driving-clock that kept Jupiter in the centre of the field of view, allowing both hands to be used for drawing. Unfortunately, we have been unable to find a photograph or a description of this telescope or the associated observatory.

Paying attention to the Jovian colours, as asked, Hirst noted the "… bright-orange-yellow of the equatorial zone." He showed his first sketches to Henry Chamberlain Russell, who was using Sydney Observatory's 11½-inch (29-cm) Schröder refractor (Pickett and Lomb, 2001: 40). As Russell, disagreed with his colours, Hirst went to the observatory to look through the large refractor himself. He found that through the refractor, the equatorial belt appeared a bright pink, just as Russell had seen. To try and clear up the confusion, Hirst examined Jupiter with Alfred Fairfax's 4¾-inch (12-cm) Schröder refractor (Orchiston, 1987: 66) and again saw the same pinkish tint. Firmly showing the differences between refractors and reflectors, Russell saw the same yellow that Hirst had seen through his self-made 10.7-inch (27.3-cm) reflector (Orchiston, 2000). One of Hirst's drawings of Jupiter, made in 1880, is shown in Figure 7.

Figure 7: Jupiter, drawn by Hirst on 27 August 1880, using Colyer's 10¼-inch reflector. Courtesy State Library of NSW (MLMSS 223).

The different tints seen through refractors and reflectors could possibly have been explained by the better achromatism of the latter, but Hirst's observations at the 1878 opposition confused the issue (Hirst, 1878). That year he was using both Sydney Observatory's 7¼-inch (18.4-cm) Merz refractor and Colyer's 10¼-inch (26-cm) reflector. He found that the discrepancy had disappeared; in a sort of compromise, through

2 Colyer came with an impeccable astronomical pedigree. His grandmother on the maternal side was a daughter of the Reverend Dr. Henry Ussher (1741–1790), the Astronomer Royal of Ireland (Wright, 1889). Apparently, Colyer was born James Cox Colyer, but at some stage changed his name to James Ussher Cox Colyer, presumably to accommodate this illustrious ancestry. He also named his house in Sydney "Eastwell" after "Eastwell House", the mansion occupied by his ancestors in County Galway, Ireland. Further details of Colyer's Irish links and his astronomical associations will be the subject of a later paper.

3 The astronomical section (Section A) of the Royal Society of NSW existed between 1876 and 1881 (Orchiston and Bhathal, 1991). The microscopical section seems to have lasted somewhat longer with Hirst presenting his papers on wool fibres to the section in 1876 (Anonymous, 1876) and diatoms the following year (Hirst, 1877a), and chairing a meeting of the section in 1884 (Anonymous, 1884). Colyer (1876) also presented a paper at a meeting of the microscopical section in 1876.

both telescopes the northern equatorial belt appeared " ... a bright coppery red ... ", while the southern appeared " ... half ochre-yellow, inclining sometimes to grey."

Hirst (1876) also saw colours in the polar regions of Jupiter: " ... a decidedly brownish green ... " around the north pole, at least through the reflector, while the south pole region appeared " ... a warm grey ... " The only earlier observation that he could find of a green tint at the poles was that of a Miss Hirst in New Zealand, who supposedly saw " ... a small oval patch of decided sea-green at the south pole ... " during the 1875 opposition (Lambert, 1875). However, there are modern doubts on whether Miss Hirst really existed (Orchiston, 2023).

A feature on Jupiter's disc, seen by both Hirst and Russell in 1876, was one that they called the "Fish" (Hirst, 1876). This bright red spot also appeared in the same position on Jupiter in 1878 (Hirst, 1878), that is, on the south side of the equatorial belt. In a letter to the *Sydney Morning Herald* on 23 July 1878, Russell (1878a) mentioned seeing the spot three nights earlier and compared it to what he saw in 1876, but he misremembered its position in the earlier year. He returned to the subject in 1880, stating that in 1878 he first saw the red spot clearly on 8 July (Russell, 1880). This date disagrees with his letter to the *Herald* and could have been an attempt to obtain priority. This may be so, since American astronomer Carr Pritchett (1879) of the Morrison Observatory in Missouri, reported seeing the spot, which we now know as the Great Red Spot (GRS), on 9 July.

The GRS possibly had appeared in earlier drawings, but, according to Thomas Hockey (1999: 125–158) in his book *Galileo's Planet*, Pritchett should be credited with its modern re-discovery. Hockey was aware of Hirst and Russell's observations of the "Fish". Ignoring Russell, he jokes that it is fortunate that it was not Hirst who was credited with the discovery, since otherwise we could be referring to the spot as the Great Red Fish!

A recent research paper examines all the available observations of large spots on Jupiter (Sánchez-Lavega et al., 2024). The authors conclude that the earliest reports of a "Permanent Spot" in the 1600s do not refer to the GRS, as that seems to have disappeared during the following century. The first report of the GRS dates from 1831, but it did not take on its present appearance of a reddish oval surrounded by the whitish area, called the Hollow, until the period

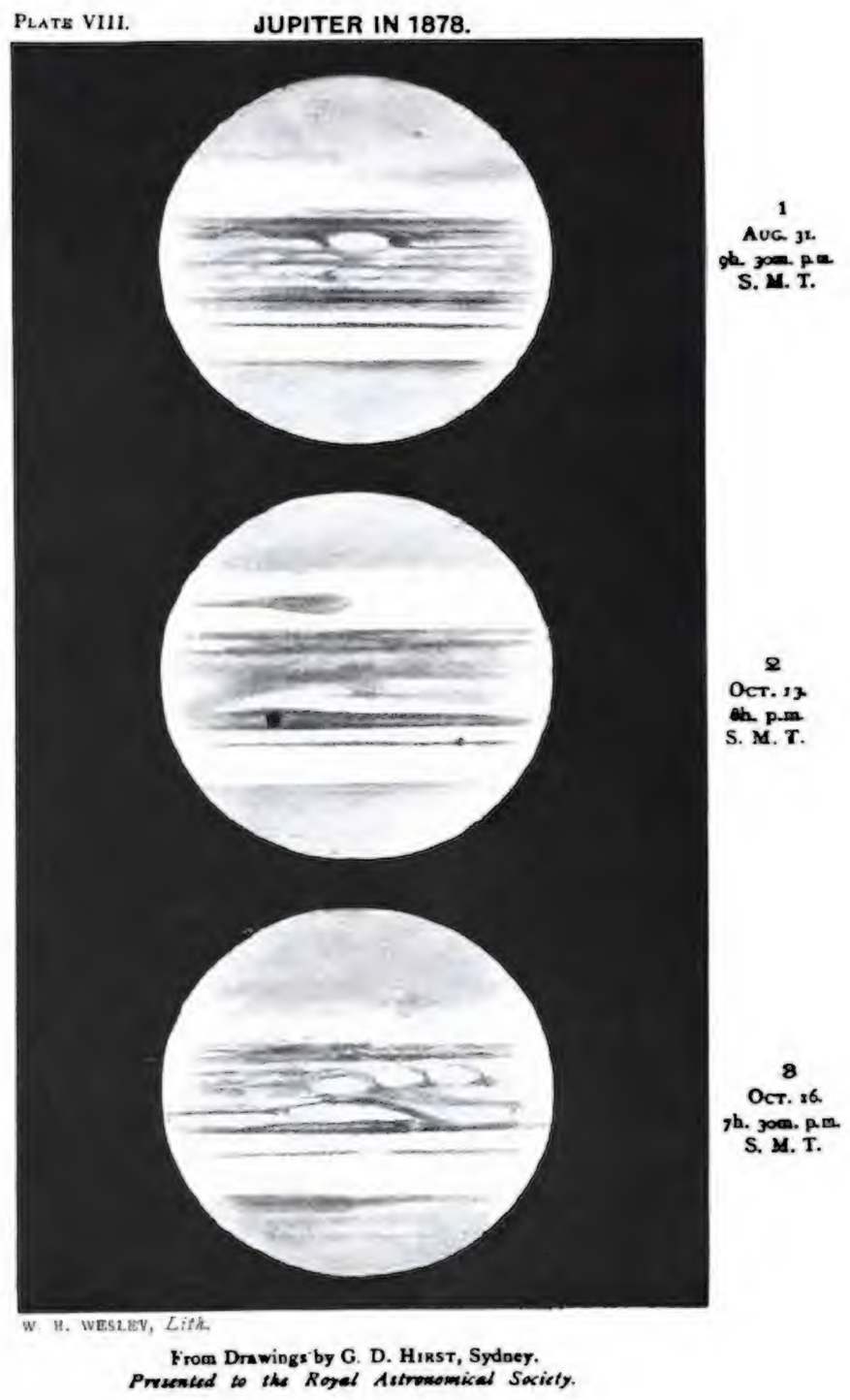

Figure 8: Hirst's drawings of Jupiter in August and October 1878 on Plate VIII of *The Sun: Its Planets and their Satellites* by Edmund Ledger.

1872–1876. Fortuitously, Hirst started observing Jupiter near the end of this period. It should be noted that during Hirst's time the GRS was three times the size it is today, spanning about 39° longitude (48,000 km) in 1880, while it was expected to be about 13° (16,000 km) in 2020 (Simon et al., 2018).

Hirst sent many of his Jupiter drawings to the Royal Astronomical Society, where 56 of his drawings are in the archives at RAS MSS ADD 18 (Bennett, 1978). His work gained international prominence when lithographs of three of those drawings were selected to appear in Edmund Ledger's book, *The Sun: Its Planets and their Satellites* (Ledger, 1882: 304–305). These are shown in Figure 8.

Shadow on the Moon

In October 1878, Russell, the government astronomer, decided to test out the suggestion that astronomical observations can be better made from a mountain than from low elevations (Russell, 1878b). Hirst volunteered to go with him as his assistant. They went to a place already familiar to Hirst, Alfred Fairfax's country residence at Woodford in the Blue Mountains, about 600 metres above sea level. Their equipment included Sydney Observatory's 7¼-in (18.4-cm) refractor, a 4½-in (11-cm) Cooke telescope plus the Hilger spectroscope that Russell had purchased in England three years earlier (Barker, 2007).

On examining the light of the Sun with the spectroscope, Russell saw many fewer spectral lines due to the atmosphere during the day, compared to that he had seen from Sydney Observatory (Russell, 1878b).[4] The lines did come back near sunset but were much sharper than they were from the lower elevation. While Russell used the spectroscope, Hirst looked at Venus near the Sun and at double stars. On the morning of 21 October at 9:05 am (Sydney Mean Time), Hirst happened to look up and saw what appeared to be a shadow on the Moon. Figure 9 shows his drawing of what he saw. The shadow was verified by Russell, who reported that it had a generally circular outline with a width about three quarters of the Moon's diameter and did not move in three hours of observation. Neither Russell nor Hirst had an explanation, though Russell commented that it could have been due to a comet of " ... more than ordinary density ... ". There is no modern explanation either, though what they saw could have been just due to their lack of familiarity of seeing the Moon washed-out by daylight at an elevated site.

While at Woodford, Russell experimented with kites to measure atmospheric electricity. In this he benefited from Hirst's " ... experience with electric kites ... ." Hirst

Figure 9: Hirst's drawing of a black shadow on the Moon, as seen from Woodford at 9:05 am Sydney Mean Time on 21 October 1878. The telescope was the 7¼-in (18-cm) Merz refractor. Image from (Russell, 1878b).

4 Spectral lines due to the atmosphere are known as telluric lines (Adelman et al., 1996). They need to be removed when measuring the spectra of stars and galaxies. As the main constituents of the atmosphere, nitrogen, oxygen and argon, decrease with altitude, so do the telluric lines.

made a smaller kite to attach to Russell's larger one. Unfortunately, the combined kite only reached a height of about 120 metres and no useful results were obtained. In another experiment, they used an electroscope, a device that measures charge on a body with two gold leaves that move apart when charge is detected. As part of the experiment, Hirst stood on an old bottle that they had found and had one hand on the electroscope, while Russell rubbed his clothes with a piece of glass. Maybe Russell did not rub hard enough, as only a minimal deflection of 20° was obtained.

Drawing

In 1904, a keen young amateur, Allan Blenman Cobham (1880–1961), gave a talk on astronomical drawing at a meeting of the NSW Branch of the British Astronomical Association (Cobham, 1904). In it, he gave some generic advice for those new to drawing at the telescope, some of which was taken from the writings of overseas astronomers. This led Hirst to provide his own advice on making astronomical drawings, based on his many years of experience (Hirst, 1904). He started by mentioning that the observer must be willing to put up with the discomfort of drawing in the open air or " ... in a draughty observatory ... ". The benefits of a clock drive on the telescope were emphasised. Hirst states that instead of a pencil, he uses " ... old French chalks [steatite, also known as soapstone], not the greasy ones that are more commonly used now." These allowed softness in the outlines and smoothness in the tints.

Hirst pointed out that colour is an essential element in a drawing. The difficulty with astronomical drawings was that they were made at night with artificial light, while they were viewed during the day. Hirst stated that an astronomical drawing " ... should represent by daylight exactly the appearance of the object as seen through the telescope ... ". He said that this was difficult at first but could be achieved with practice by subduing some of the colours, while making the drawing. At the same time, he stressed that once drawn at the telescope, the drawing should not be altered for artistic effect.

The Maunder incident

Hirst was president of the New South Wales Branch of the British Astronomical Association during the 1904–05 session. As was traditional at the end of the term, he gave a presidential address. In presenting his report on 17 October 1905, Hirst (1906a) summarised the activities of the branch for the year, as well as the latest advances in astronomy. There was much of interest in his address:

- The presentation by the Royal Astronomical Society of the Jackson-Gwilt Medal and Gift " ... to our esteemed Member and senior amateur astronomer in this state, Mr. John Tebbutt."[5]
- The retirement due to ill-health of the Government Astronomer, Henry Chamberlain Russell. Hirst spoke of how he worked closely with Russell on a number of projects, including the transits of Venus in 1874 and 1882. He related that "In the old days his advice and assistance were ever at my disposal ... ".

5 Tebbutt retained the Medal but donated the Gift of £25 to the New South Wales Branch of the British Astronomical Association (Anonymous, 1905).

- Hirst berated the members for the lack of original work. He said that both the astronomical and the microscopical sections of the Royal Society of NSW had collapsed as only half a dozen members did any research work in each of them.[6] The two sections were now " ... as dead as Julius Caesar."
- He asked the rhetorical question about whether scientists were " ... not approaching a limit beyond which we cannot reach ... ". Hirst answered his own question in the negative suggesting that the future held " ... some new science, some new development, some hidden law ... ".[7]

Perhaps the most interesting item in the presidential address, and one that became controversial, was Edward Walter Maunder's work on the solar origin of terrestrial magnetic disturbances. Maunder (1851–1928) was an astronomer at the Royal Observatory, Greenwich, who studied the Sun. Hirst referred to Maunder's "theory" that there is a magnetic meridian on the Sun that, when facing Earth, produces magnetic disturbances. Further, "Mr Maunder makes out a fairly strong case for his theory ... but it has been subject to strong criticism ... ".

When Maunder, in England, read Hirst's comments in the *Journal of the British Astronomical Association*, he was sufficiently incensed that he wrote an article for the next issue clarifying his conclusions and stating how Hirst was mistaken (Maunder, 1906). Maunder explained that his results were purely empirical and hence fact and not a theory. He said that he had shown that magnetic disturbances are connected to the Sun, on restricted areas on it, and "That the sun's action is not radiated but restricted in direction." Moreover, his paper on the subject had met with comments, but not strong criticism.

Hirst took the chastisement well (Anonymous, 1906). He said that he did not regret his misunderstanding as it led to a second paper from Maunder, in which some previously obscure points were " ... most lucidly explained."

Mars

Hirst observed Mars during its 1877 opposition and sent a drawing to the Royal Astronomical Society. This is still in the society's archives at RAS MSS ADD 19 (Bennett, 1978). In a note dated 24 August that accompanied the drawing (Hirst, 1877b), Hirst stated that the drawing was made using a 10¼-inch (26-cm) reflector (Colyer's). He reports that "Until lately the markings on Mars have been very indistinct, or almost invisible." However, he said that in the last few days before writing the note the view had cleared, whether " ... in our own atmosphere or that of the planet ... ". Hirst continued to observe Mars after writing the note. As shown in Figure 10, he drew Mars on 3 September using Sydney Observatory's large refractor, stopped down to 7 inches (18-cm) aperture.

The 1877 opposition, at which Mars was closest on September 2 (Pearce, 1924), was a momentous one. In the weeks before Hirst sent off his drawing, American astronomer Asaph Hall (1829–1907) discovered Mars'

6 This was not a fair assessment of the demise of the astronomical section, as other non-observational factors were also involved, (see Orchiston and Bhathal, 1991).

7 This hope or prophecy soon came true, for Albert Einstein (1879–1955), a young patent clerk in Switzerland, in the same year of 1905, revolutionised science and astronomy with a series of seminal papers (Stachel, 1998).

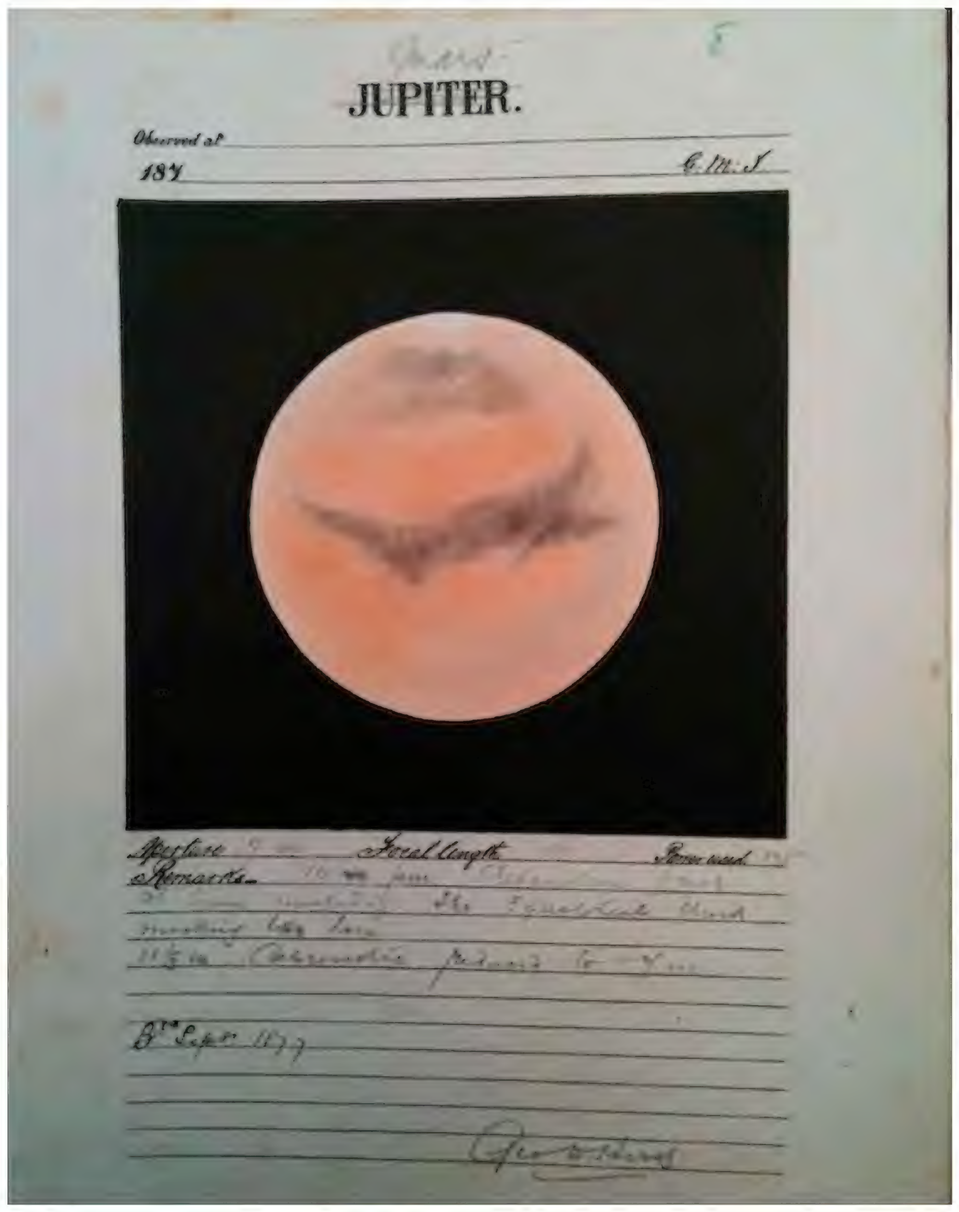

Figure 10: Hirst's drawing of Mars on 3 September 1877 using Sydney Observatory's 11½-inch refractor, stopped down to an aperture of 7-inches (18-cm). Courtesy State Library of NSW (MLMSS 223).

two moons, Phobos and Deimos, at the United States Naval Observatory (Sheehan, 1996). Moreover, that was the opposition at which the Italian astronomer Giovanni Viginio Schiaparelli (1835–1910) drew his famous map of Mars with thin markings that he called, in Italian, "canali." This began a whole plethora of people claiming that there was intelligent life on the planet, (see Putnam and Sheehan, 2021). Despite his success in mapping the whole planet, Schiaparelli explained that during his observing period from September to December 1877, large parts of the planet were obscured (Moore, 1973). This observation of a dust-storm probably explains Hirst's report of seeing indistinct markings on the planet.

Double stars

Since Hirst had access to a number of telescopes, such as Colyer's 10¼-inch (26-cm) reflector and the 7¼-inch and 11½-inch refractors at Sydney Observatory, he did not obtain his own telescope until 1904. That year Sydney Observatory disposed of the smaller telescopes left over from its various transit programs and from them, Hirst acquired a fine 4¼-in (10.8-cm) Cooke refractor on an equatorial mounting, together with a filar micrometer (Orchiston, 2017a: 299–300). Hirst put his new acquisition to good use, so much so that he had to learn how to replace the strands of spider's web on the micrometer. On 18 June 1907, Hirst shared his experiences with members of the NSW Branch of the British Astronomical Association in a surprisingly humorous presentation, titled "Some Remarks on 'Wiring' Astronomical Instruments" (Hirst, 1907). The first step, he said, was to capture a spider of suitable size, so that its web was not too coarse nor too delicate. He notes that

> Spiders do not take kindly to captivity, so that the sooner you get one to spin after it is captured the better. They are also pretty short-tempered, and after being poked about with a stick will sulkily refuse to spin.

A year earlier, he presented to the Branch some observations of the famous southern double star, α Centauri, made with the Cooke refractor and the micrometer (Hirst, 1906b; 1906c). He measured the separation of the two main stars as 21.06 arcseconds. He also measured a number of fainter stars near to the main pair that Robert Innes, then at the Transvaal Observatory in South Africa, had suggested as possible companions. Sub-

sequently, Innes (1915) found Proxima, a real part of the α Cen system (Glass, 2008) and the other supposed companions have been forgotten.

Hirst expanded his double star project with the Cooke refractor to other known southern double stars. This work culminated in two papers published in the *Monthly Notices of the Royal Astronomical Society* (Hirst, 1910a; 1910b). In the first he provided measures of 30 stars, while in the second there are 10 stars measured. Demonstrating his impressive knowledge of the sky, Hirst says that he made the measures for α Cen and another bright double star Θ Eri in daylight.

Microscopy

Hirst was an enthusiastic member of the microscopical section of the Royal Society of NSW, being at times its secretary and its chair. One of his first papers to the section was "Action of alkali on wool fibres" (Anonymous, 1876). Woolgrowers at the time used strong alkalis to clean wool after it had been sheared. Under examination with a microscope, Hirst found that after removal of the wool's natural grease, the alkali damaged the wool fibres.

Marine creatures were also studied. In 1877, Hirst gave a talk to the microscopical section on diatoms (Hirst, 1877a). These tiny unicelled algae with two-part cell walls of transparent silica, are important as they provide much of the organic matter for the marine food chain (Armbrust, 2009). As well, through photosynthesis they provide much of the oxygen that we breathe and are an important part of the carbon cycle. In his talk, Hirst related how he took a sample from " ... thick brown scum ... " underneath some logs in Darling Harbour, Sydney, and obtained a variety of diatoms. He explained how to clean the original scum, how to preserve the diatoms and how to mount them for microscopy. Hirst also studied tiny, microscopic animals from the genus *Brachionus* (Figure 11).

Figure 11: A microscopic view of a tiny animal that belongs to the genus *Brachionus*, drawn by Hirst. This appears to be an adult female with two eggs hanging off it, on either side of its foot. Courtesy Philip Moors.

As in astronomy, having good quality equipment was important in microscopy. In another talk to the section, Hirst discussed two new objective lenses from Carl Zeiss of Jena (Hirst, 1879). As one of these was an oil immersion lens, Hirst explained that if the oil matches the refractive index of the cover glass, then no correction was needed for the cover. He also evaluated a water immersion lens and concluded that "They are wonderful lenses, especially when their cost is considered ... ". This was because Zeiss' lenses were less than half the cost of similar lenses from their London rival, the then well-known firm of Powell and Lealand.

Discussion and concluding remarks

George Denton Hirst was one of a number of keen and competent amateur astronomers in Sydney, many of whom lived in the same suburb of Mosman where he did in the latter decades of his life. What made Hirst stand out among the local astronomers was his exceptional drawing and observational skills. When, in 1877, he sent his drawing of Mars to the Royal Astronomical Society, he sent it via the well-known instrument maker John Browning (c.1831–1925). In acknowledging receipt of the drawing, Browning (1877) said, "Your drawing is the best I have seen for a long time." His obituary in the *Monthly Notices of the Royal Astronomical Society*, compared Hirst's drawings of Mars with that of Nathaniel Everett Green (1823–1899), a professional artist who gave lessons to Queen Victoria (Anonymous, 1916; Baum, 2014).

During his four decades as an amateur astronomer, Hirst had a variety of interests, including observing planetary transits, making one of the most important observations among the New South Wales team of astronomers during the 1874 transit of Venus, and double stars. He was always willing to share his experiences such as in drawing or on how to "rewire" a micrometer. A small group of amateurs often met at his home in Mosman and criticised each other's observations (Anonymous, 1916). Hirst was also willing to give his time to the local astronomical group, the New South Wales Branch of the British Astronomical Association, by serving on its committee, as he did with the various other groups, scientific or otherwise, that he supported.

Hirst is best known for his observations of Jupiter. Together with Henry Chamberlain Russell, with whom he worked closely, he was among the first observers of the planet's Great Red Spot in its modern manifestation. His drawings of the planet are kept in the archives of the Royal Astronomical Society in London. He received an international reputation when three of his drawings of Jupiter were chosen from among those in the RAS archives to illustrate Edmund Ledger's book, *The Sun: Its Planets and their Satellites*.

During Hirst's time as an amateur astronomer, his fellows were carrying out on-going systematic observations of variable stars, comets, Jovian satellite phenomena, lunar occultations of stars and other phenomena of an occasional nature, such as lunar and solar eclipses, lunar occultations of planets, planetary conjunctions and conjunctions of stars and planets. Some of them were also building telescopes. Instead, when Hirst had access to Colyer's 10¼-inch reflector, he concentrated on planetary observations, and when he had his own telescope, he was enamoured with double stars. Possibly, due to lack of time, he sensibly built on his own interests and strengths, as well as on what he could achieve with the equipment that he had at his disposal.

Hirst made an important contribution to 19th and early 20th century NSW amateur astronomy. He is remembered today in Giralang, a suburb in the Belconnen district of the Australian capital, Canberra (Fuller, 1995). As Giralang is the word for star in the language of the Wiradjuri people, all the streets in the suburb are named after the names of stars and constellations, both First Nations and Western, and after notable Australian astronomers. Hence, Hirst Place is off Canopus Crescent.

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We are most grateful to Dr Philip Moors, who directed us to important sources of information on the work of his great-grandfather, George Denton Hirst. As well, he provided photographs and other family memorabilia on Hirst directly to us and, indirectly, through his 2014 donations to the Museums Victoria Collections. We are also grateful to Anthony Kinder, who provided Hirst's details from the records of the British Astronomical Association and to Garry Dalrymple for supplying records from Trove about Hirst's friend J.U.C. Colyer. Professor Richard de Grijs and an anonymous second referee made helpful comments that improved the paper.

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Book Launch

Knowledge for a Nation. Origins of the Royal Society of New South Wales by Dr Anne Coote

The book launch included words from the Society's patron, Her Excellency the Honourable Margaret Beazley AC KC; Dr Caroline Butler-Bowdon, NSW State Librarian; the President, Dr Susan Pond; and the author, Dr Anne Coote. There is a review by the Vice President, Dr Peter Shergold.[1]

Our Society's Patron, Her Excellency the Honourable Margaret Beazley

I am delighted to be part of this evening's event and to say a few words about the launch of *Knowledge for a Nation*. The role of Governors within the Society's story features throughout the book, and as Patron I'm proud that our close association continues today.

The halls of Government House contain portraits of many of the 19th-century characters featured in the book. In the main hall there is the striking painting of Thomas Brisbane, the 6th Governor of New South Wales, President of the short-lived Philosophical Society of Australasia, established in 1821. His love of astronomy is expressed in this first full-body portrait commissioned in the Colony by the inclusion of his books, maps, and the spherical astrolabe in the left-hand corner.

Then, Sir William Denison, the 11th Governor, whom Dr Coote described as a skilled engineer and knowledgeable conchologist, with an interest in other aspects of Natural History. His invigoration of the Philosophical Society of NSW in 1855 was a crucial next step towards the development of the Society as we know it, even though the popular

Sir William Denison. Photograph courtesy of Government House, Sydney.

press at the time questioned whether his "scientific Excellency" would also be a practical philosopher, capable of writing his name

1 These addresses were given at the launch of Anne Coote's history of the Royal Society, *Knowledge for a Nation*, on 2 October 2024; see https://www.youtube.com/watch?v=To_QO2Fb-mc&t=6s

on the railways, the electric telegraph and the fortifications of New South Wales.[2]

The last portrait I want to mention is a young Queen Victoria, displayed in our ballroom. In the second half of 1866 Her Majesty gave assent to the adoption of the title "Royal," allowing the inaugural general meeting of the Royal Society of New South Wales to proceed in the following year.

As a repository of this art, Government House is an expression of both the past and present relationship between Governors and the Society, featuring these 19th century characters, while continuing to host significant 21st-century Royal Society events, including the Royal Society and Learned Academies Forum. In November there will be lively discussions on the 2024 theme, "Threats to Democracy."

We also welcome hundreds of visitors each year who come to participate in our collaborative effort *Ideas@theHouse*, a vibrant platform exploring important and influential ideas. Since its first iteration — which was online, as COVID was upon us — we've discussed Colonial mapping, music, science, Shakespeare, philosophy, politics and — courtesy of Richard Tognetti — even considered the theme of nothing. At the end of this month we will turn to a discussion of the law of the sea.[3]

I congratulate the Society and Dr Anne Coote for this wonderful history, and — without wanting to put out any spoilers — find it is entirely appropriate that the book challenges some of the long-held beliefs regarding the Society's antecedents. In doing so it's an exemplar of the motto of the Society: *question everything*. May the Society continue to go from strength to strength as you enrich lives through knowledge and promote the research, inquiry, discussion, and debate so critical to our future.

Dr Caroline Butler-Bowdon

We are thrilled to have you all here at the State Library to celebrate this milestone moment and the launch of *Knowledge for a Nation*. I begin by acknowledging country. The State Library of NSW acknowledges the Gadigal people of the Eora Nation, the traditional custodians of the land on which the Library stands. I pay respect to Aboriginal elders, past, present and future, and extend that respect to other First Nations people.

The Library has had a close relationship with RSNSW since the 1970s, so it is so fitting that the book is launched here tonight. It was first suggested — more than 60 years ago — that RSNSW archives be deposited at the Library, but these transfers did not commence until 1995, when the Royal Society itself was facing challenges. It is now the case that nearly all the Society's archives are in the custody of the State Library.

Indeed in many ways the Royal Society and the Library can point to similar origin stories. Both organisations can trace their origins back to the 1820s, and both organisations, like so many of the era, relied on the same pool of educated, upper-middle-class gentlemen to administer them. Crucially, they were both inspired by a belief that the pursuit of science, literature and culture was important for colonial development.

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2 See "Denison and Science." *Bell's Life in Sydney*, Feb. 3, 1855, p.2. [Ed.] https://trove.nla.gov.au/newspaper/article/59759779

3 Timothy Stephens, The big thaw: who governs Antarctica's ice? 31 October 2024; see https://www.youtube.com/watch?v=XiHTYy5_dfw

The Australian Subscription Library, which was established in 1826 and whose collections were purchased by the NSW Colonial government in 1869 to establish the Free Public Library, touted access to the latest scientific and political journals from Europe as one the advantages of belonging to it. Not surprising, then, that many of the earliest iterations of scientific societies which preceded the formal establishment of the Royal Society chose to hold their meetings in the rooms of the Australian Subscription Library.

Dr Anne Coote's excellent *Knowledge for a Nation: Origins of the Royal Society of New South Wales* is a crystal-clear and beautifully constructed exposition on the intellectual milieu, international parallels and the political machinations behind the creation and administration of the Royal Society. It helps inform not only the history of science in NSW, but more broadly the larger intellectual climate of Australia.

The book is built on the foundation work of the late Dr Peter Tyler, who was the inaugural (2008) Merewether Fellow at the Library. His fellowship focused on the history of learned societies in NSW with an emphasis on the Royal Society. Our Fellowship programme (which turned 50 this year) is so important in so many ways. Often it is years later when we see the public presentation of the research in books, films and in so many other formats. Dr Coote notes in her acknowledgements a debt of gratitude to Dr Peter Tyler.

Knowledge for a Nation is a book which is genuinely engaging: this is not something we can take for granted in the field of institutional or corporate histories! As noted in the foreword, the storytelling is compelling not only because of her expertise as an historian and author but also her expansive and deep research during the past ten years. It takes the story outside the constrictions of Royal Society personalities, into the much more significant world of colonial society and politics. There are surely parallels between the impulses which inspired colonial scientists and natural history collectors and enthusiasts with book collectors like David Scott Mitchell who, in the 1870s and 1880s — the heyday of the Royal Society — was actively compiling his library of Australiana books, manuscripts and pictures, which he ultimately gave to the State, and which formed the nucleus of the Mitchell Library.

I was particularly interested in Chapter 8, "Women and the Royal Society," that explores the role of women, and their access to learning and learned societies, in the 19th century. The determinedly male leadership of the Royal Society in many ways was also reflected in the exclusively male composition of the Library's administrative boards. The often expressed fear that a woman's constitution could not bear the rigours of science and its pursuit is perhaps paralleled by the Library's anxiety about popular fiction which was thought to be enervating and immoral. When the Australian Subscription Library collections were acquired by the NSW Government in 1869, the popular fiction collection was sent to the Gladesville Lunatic Asylum. Only classic, morally acceptable, fiction — Charles Dickens, Sir Walter Scott, William Thackeray, Jane Austen etc. — was retained. Dr Coote's evocation of this period is an important addition to our understanding. As Dr Coote remarks: "However scientific its goals, the Royal Society of New South Wales remained

a gentlemen's club. Women would not be allowed to join it until 1935."

Women were, however, encouraged to attend the splendid conversazione events which from 1879 were usually held in the Great Hall of the University of Sydney. It was a coming together of self-improvement, entertainment and social connection — clearly fashionable and popular events bringing to the fore science and technology for a wide audience. They also underscore the value of the Society as a leading learned body that was thoroughly up to date. I learnt from the book that each Ordinary member of the Society was allowed to bring two female relatives. In November 1879, the *Australian Town and Country Journal* depicted on its cover the lively crowd attending the first RSNSW conversazione in the Great Hall, with a large number of women present.[4] Wonderful to see the cover of the book is a detail from an illustration of the RSNSW conversazione held in the Great Hall, Sydney University, published by the *Illustrated Sydney News*, 25 October 1884.

Many of its collections, now held in the Mitchell Library, have been instrumental for the writing of the book. Apart from the Society's own archive, the Rev. W.B. Clarke papers, the Edgeworth David papers, Lawrence Hargrave papers, to name a few, have helped inform *Knowledge for a Nation*. The Library has also been delighted to be able to support the book through the provision of the majority of its illustrations.

While this book necessarily focuses on origins, the Library happily maintains a very contemporary relationship with the Royal Society. I thank our brilliant Mitchell Librarian, Richard Neville, who has shared the history and background of the association between the Library and the Royal Society with me.

Since 2017 our relationship has grown much closer, under the advocacy of Dr John Vallance, my predecessor, with the signing of a 2023 MoU formalising this collaboration. The Royal Society now meets at the Library; its own collections, once properly assessed, arranged and described, will also be lodged here. The association between the Society and the Library has been long running and the original Minute Book of the Philosophical Society of Australasia (June 1821 to August 1822) is held in the collection. And of course the book begins with an account of Australia's first learned society, the Philosophical Society of Australasia (1821–1822), which is the Royal Society's enduring inspiration, if not its earliest incarnation, as noted in the publicity for the book.

As both the Society and the Library look to the future, we also find strength and understanding in interrogating our surprisingly parallel pasts. Of course, *Knowledge for a Nation: Origins of the Royal Society of New South Wales* tells the early history of a learned society still active in the intellectual culture of 21st century Australia. Dr Coote's *Knowledge for a Nation* beautifully captures this story.

Congratulations, Dr Coote; congratulations, the Royal Society. I officially launch this book, *Knowledge for a Nation*.

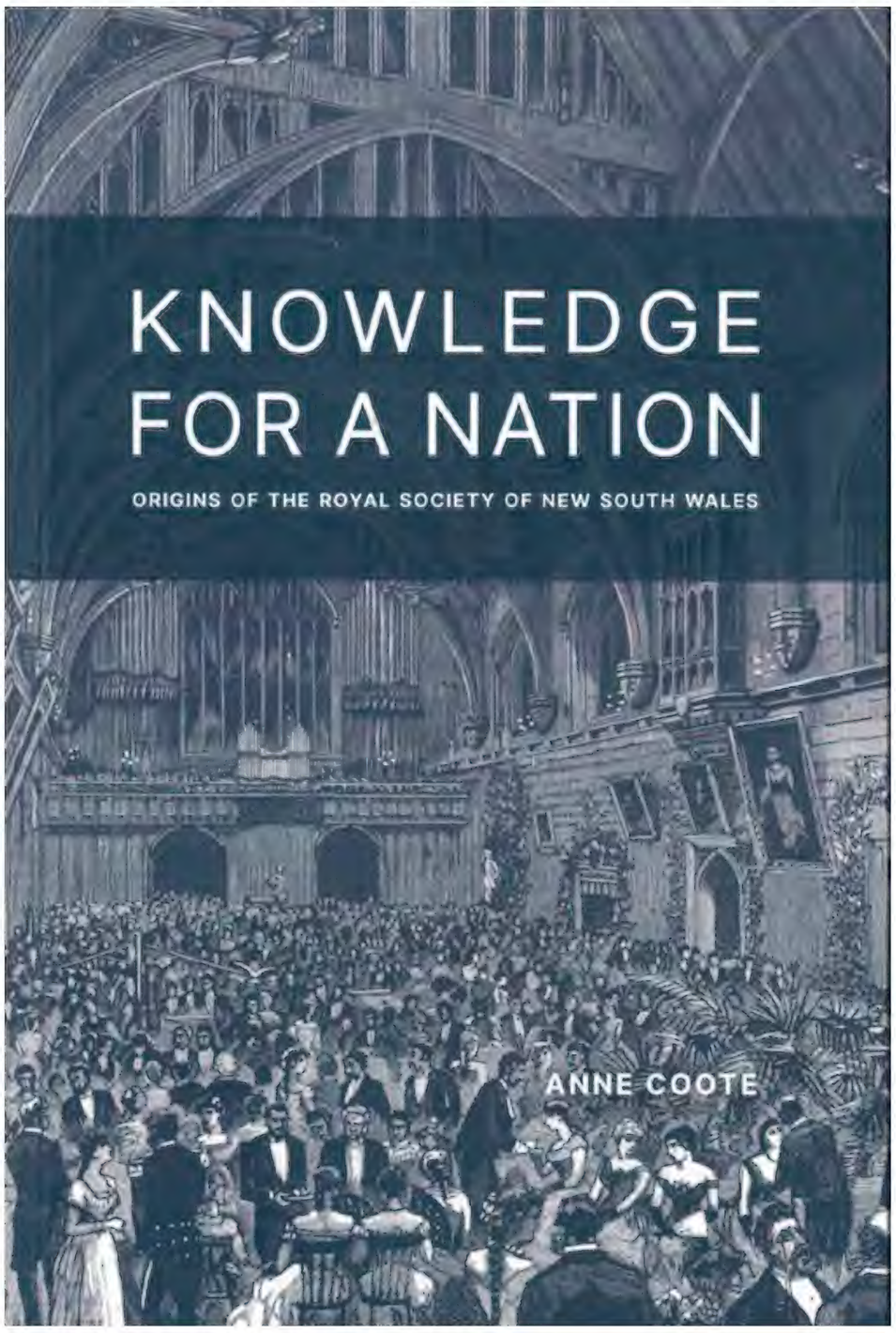
4 See https://trove.nla.gov.au/newspaper/article/70974410

Dr Anne Coote

Good evening, everyone. Thank you for coming tonight. Thank you, Dr Butler-Bowdon, for your thoughtful and generous words in launching my book. My gratitude is also due to the Royal Society President, Dr Susan Pond for initiating its publication, to the publishing committee for their contribution, and especially to Dr Davina Jackson who has devoted so much of her own time, energy and expertise to editing the manuscript and carrying it through to publication. I also want to acknowledge the late Dr Peter Tyler, whose untimely death prevented him completing his Royal Society history.

We're told that you shouldn't judge a book by its cover, but I think this one gives a pretty good indication of what's to be found inside. As its subtitle indicates, my book is about beginnings. It takes the Society's story from its foundation up to the outbreak of World War I. The Society was at the peak of its public prominence in this period. Its monthly meetings were reported in detail by Sydney's leading daily papers, the *Sydney Morning Herald* and the *Empire*. Those articles were often copied, at least in part, by other journals, including country newspapers, which multiplied during the second half of the nineteenth century. Of course, not everybody read those reports, but most readers would have at least been aware of the Society's existence. More important, it was also during this time that the Royal Society of New South Wales contributed substantially to the development of an active scientific community in New South Wales.

The main title, *Knowledge for a Nation* sums up what the book has to say about the Royal Society's purpose at this time — to



foster knowledge creation for the national good. Officially that knowledge included "science, art, literature and philosophy." A Royal Society section, devoted to the arts, did exist briefly during the late 1870s, but in practice members focused almost entirely on science, mathematics, and subjects now considered part of the social sciences such as ethnology and economics. Developing the resources of Australia was the Royal Society's stated objective, but in practice, the focus was largely on the colonial nation, New South Wales.

The cover image is an artist's impression of the gala conversazione held by the Royal Society in 1888 to mark the first meeting in Sydney of the Australian Association for the Advancement of Science (AAAS). Its venue was the Great Hall of Sydney Uni-

versity. The Society's close connection with this institution is another theme of the book.

A whole chapter is devoted to the character and significance of the Society's conversaziones. It is one of five thematic chapters which are sandwiched by a chronological account of the Society's history, told against the background of colonial history and developments in the discipline of science. Chapters 1 to 4 narrate the Royal Society's development up to and including the 1880s. Chapter 10 follows the Society through its vicissitudes from the 1890s. This is not a triumphal account of ongoing and inevitable progress. Hiatus, unsatisfactory accommodation, falling membership and financial crisis are all part of the story. Fortunately, the vision and commitment of a few members allowed the Society to continue with its work. In the new century it also experimented with measures to attract members, undertook renovations and was active in the formation and organisation of the AAAS.

The book concludes with the 1914 visit to Australia of the British Association for the Advancement of Science (BAAS). Taken as metropolitan recognition for the existence of a viable Australian scientific community, this event was certainly gratifying for the Royal Society. But — spoiler alert — it was also something of a reality check.

Like most previous and current accounts of the Royal Society's history, my book begins in 1821 with an account of the first learned society formed on Australian soil — the short-lived Philosophical Society of Australasia (1821–22). This has long been claimed as the Royal Society's earliest incarnation. In the spirit of the Society's own motto — *Omnia Quaerite* or *Question Everything* — I examined the veracity of the Royal Society's foundation story, and found it wanting. Peter Tyler reached the same conclusion, and, as long ago as 1918, so did the Society's past President and long-serving Honorary Secretary, Joseph Maiden. It was "not historically correct," said Maiden, for the Royal Society to claim "lineal … or even collateral descent" from the Philosophical Society of Australasia. That body, he said, was better understood as the Royal Society's "forerunner" and its "exemplar."

The 1821 society could also be regarded as the forerunner of the several learned societies founded in New South Wales from 1822 to 1850. But the earliest body for which there is any evidence of a direct connection with the Royal Society, is the Australian Society for the Encouragement of Arts, Science, Commerce and Agriculture. It was formed in 1850. Its energetic Secretary was Henry Grattan Douglass. As a young man, he had also been Secretary of the Philosophical Society of Australasia. But this is hardly proof that the Australian Society of 1850 was the 1821 society, woken like Rip van Winkle from a sleep of nearly 30 years. Indeed, as a body dedicated to the application of science to the colony's economic development, the Australian Society had more in common with the several agricultural, viticultural and horticultural societies formed since 1822.

The final meeting of the Australian Society occurred in May 1851, just as news of the gold discoveries near Bathurst were creating chaos in Sydney. But several years later, members of the Australian Society helped found the Philosophical Society of New South Wales, bringing with them what was left of the Australian Society's funds. In 1850, Governor William Denison had summoned the remaining Australian Society

members to a meeting at the Royal Hotel where they agreed to reorganising under his presidency. Denison was an engineer and a knowledgeable conchologist with an interest in other aspects of natural history. Science for Denison was much more than a private intellectual indulgence. It was an instrument of public policy — a resource that governments should foster.

I probably don't have to tell you about the disadvantage to a learned society of having no dedicated building. That was the lot of the Philosophical Society of NSW. Initially, it met in the Sydney Mechanics' School of Arts in Pitt Street, but meetings soon moved to the Australian Library and Literary Institution, located on the corner of Bent and Macquarie streets, just across from where we meet tonight.

Lack of a building was the least of Philosophical Society's problems. The first couple of years had been promising. Some 90 men had applied to join at the first meeting. By May 1858 there were 174 members and the previous year's income was nearly £205, so, flush with funds, the Society purchased some debentures. But income was only £114 over the same period to May 1863 and in 1866, the Society's bank account was overdrawn by more than £33.

There were signs of demoralisation in the Council of Management. At 16 of the 61 Council meetings from January 1861 to November 1866, only three Councillors were present. For 20 programmed meetings, no quorum could be mustered at all. Attendance at general meetings was also poor. On one occasion only the Governor (Sir John Young), Vice-President John Smith, and the scheduled speaker bothered to come.

The Council's response was to form a committee. Its two members — George Smalley, the Government Astronomer, and Edward Bedford, the Government Medical Advisor — suggested a number of ways to enhance the Society's appeal. Only one of these really had legs: changing the Society's name. Queen Victoria's permission to adopt the title "Royal" was received in December 1866.

At the Royal Society's inaugural general meeting in 1867, senior Vice-President, the Reverend William Branwhite Clarke, told members that the utilitarian "*especial* object" of their research should be "the development of the Physical character of the country we live in, and the development of its Natural History and Productions." Public perception of the Royal Society's relevance to colonial development was enhanced in 1870 by a series of eight well-publicised and quite fiery meetings devoted to the subject of Sydney's future water supply. Twenty-one new members were recruited as a result. But too many men were failing to pay their subscriptions. Revenue raised during 1870 was just over £112, less than could be expected from 129 enrolled members paying one guinea each, including the 21 new ones, who also paid an entrance fee. Many on the roll had apparently lost interest and considered themselves to have resigned. By the beginning of 1871, the Society could barely make ends meet and the following year, it had to sell the last of its debentures.

But salvation was on the horizon in the form of a new member, Archibald Liversidge, soon to be Professor of Geology and Mineralogy at Sydney University. He joined the Royal Society in November 1872, became a Council member in 1873, and in 1875 was elected Honorary Secretary, along with Carl Adolph Leibius, a long-term Society member. Under their leadership, and

with the support of influential men such as Clarke and the Government Astronomer, Henry Chamberlain Russell, the Royal Society was re-organised and re-invigorated.

Even before his election as Secretary, Liversidge had managed to find the Society better accommodation. Since 1869 meetings had been held in the Exchange Building, located at the junction of Pitt, Bridge, and Gresham streets. In 1875, Liversidge secured access to two rooms, sub-leased from the Society of Arts, in a building known as Clark's Assembly Rooms located at what is now 5 Elizabeth Street. This building was sketched by Joseph Fowles for his book, *Sydney in 1848*.[5] A former dancing school, it had a good-sized ballroom (55 feet × 25 feet), useful for meetings, on its ground floor. It stood on the western side of Elizabeth Street, just a few doors up from Hunter Street, in the direction of King Street.

The next goal was to obtain freehold. Applications to the colonial government for financial assistance eventually bore fruit. Late in 1877 the government promised an annual subsidy for running expenses and a large one-off grant to purchase a building, both proportional to money raised by the Society. With members' contributions and a substantial donation from local philanthropist Thomas Walker, the Royal Society purchased its Elizabeth Street headquarters in 1878.

A second storey was added in the 1890s and a third in 1906. In 1911 serious structural problems caused the Society to contemplate relocation. Architects Mansfield and Son were engaged to draw plans for a purpose-built building on a potential site in Phillip Street. A purchaser offered £11,000 for the current building but no record survives to explain why the sale and rebuild did not proceed.

Guided by Liversidge, the Royal Society was effectively reborn. Rules governing the vetting of new members, discouragement of fee defaulters, attendance at Council meetings and the regularity and conduct of general meetings, were tightened or extended. Liversidge took over as editor of the Society's *Journal* and a system of publication exchange was introduced with institutions and learned societies in the colonies and abroad. This allowed the Society to accumulate an up-to-date scientific library, of great use to colonial scientists like physicist Professor Richard Threlfall, who found it superior for his purposes to Sydney University's library. As a measure of the Society's reinvigoration, membership increased from 176 in 1876 to 494 in 1884.

The Clarke Medal, awarded for "meritorious contributions to the Geology, Mineralogy and Natural History of Australasia," was one of a range of measures, implemented from the 1870s to encourage original research. They included the appointment of honorary members, the introduction of specialist sections and essay prizes for original research. These are discussed in detail in two chapters of the book.

Arguably the most effective means of encouraging local scientists were the Society's now regular monthly meetings. Members could present their research, benefit from the ensuing discussion and later have their polished work published in a Journal that was exchanged with institutions across the world. Many papers dealt with issues relevant to colonial development

5 See Fowles J *Sydney in 1848*. Sydney: D Wall (1848). https://gutenberg.net.au/ebooks06/0600151h.html [Ed.]

including water supply, this time in the interior. Members with expertise in geology, meteorology, engineering and chemistry focused their attention on the subject of artesian water.

Members' papers also reflected developments in the discipline of science. Lawrence Hargrave kept members informed about his experiments in aeronautics. Other papers reflected their authors' interest and expertise in new specialties, such as phytochemistry, food chemistry and parasitology. Hargrave was an expert amateur, wealthy enough to fund his own work. Over time more presenters were formally qualified professionals: university personnel and men employed by institutions like the Sydney Technological Museum, the Bureau of Microbiology, and the government departments of agriculture and mining.

I'll conclude by saying something about the membership. After all, it was members' shared assumptions, values and goals that underpinned corporate action. Professional scientists (including medical practitioners) joined the Royal Society and its earlier incarnations. There were also clergymen, lawyers, parliamentarians, businessmen, journalists, artists and clerks — only some of whom any had any scientific expertise. This was not a prerequisite for membership. Paramount was a man's reputation for gentlemanly behaviour. He had to fit in, so there were strict rules for vetting applicants. They had to be nominated and seconded by existing members and have their applications read at two (and later three) monthly meetings. One negative vote in five was sufficient to exclude them.

James Samuel Palmer, a taxidermist, dealer in natural history specimens, and self-described "ornithologist," was invited to exhibit his birds at a Royal Society conversazione in 1869. He would never have been accepted as a member. This was not only because he was a former convict, whose stepdaughter had been involuntarily connected with a notorious murder. Palmer's own reputation for honesty was also somewhat questionable. The convict stain was less important a generation on. Mayor of Sydney, James Merriman, who was the son of a convict, was welcome to join, as was the Australian Museum's Curator, Edward Pierson Ramsay He was a grandson of the convict emancipist, Simeon Lord.

One of many Society members of interest was Joseph Dyer, who joined the Philosophical Society of NSW in 1857. Between June 1857 and June 1859, he edited the *Sydney Magazine of Science and Art*, published by James Waugh, which printed papers read before the Society. Since arriving in the colony, he had been a journalist, Secretary of the Sydney Mechanics School of Arts and one of its lecturers, and Secretary of the Sydney Insurance Company. Always full of ideas for projects and inventions, "secretary-savant Dyer," according to *Sydney Morning Herald* columnist, "Peter Possum," was a familiar figure on Pitt Street, "dashing hither and thither in a superbly swinging hansom." He died in New Zealand, where his granddaughter, Katherine Mansfield would become one of that country's distinguished authors.

Eliezer Montefiore[6] was the manager of the Pacific Fire and Marine Insurance Company. He chaired the Royal Society section

6 He lived at Hampton Villa, Grafton Street, Balmain, the later residence of Sir Henry Parkes. [Ed.]

devoted to the arts. He was a member of the Academy of Art, a trustee of the Sydney Art Gallery and an artist in his own right. Born in Barbados, he was one of several members with connections to slavery. His mother's cousin had jointly loaned the British Government £15 million, to fund the compensation paid to British slaveholders, following slavery's abolition from 1834.

Henry Chamberlain Russell established three regional stations for observation of the transit of Venus in 1874. Two notable Royal Society expert amateur astronomers were stationed at Woodford in the Blue Mountains. They were surveyor Frederick Eccleston du Faur and wine merchant George Denton Hirst. Hirst led the Sydney branch of the British Astronomical Association and was later an honorary member of the Royal Astronomical Society.[7] John Tebbutt, another expert amateur astronomer among the members, earned international recognition for discoveries made at his own observatory at Windsor. His strained relationship with the Government Astronomer, mostly played out publicly in print, was a side-effect of the increasing professionalisation of science. Animosity surfaced briefly at one Royal Society meeting where Russell, having read out Tebbutt's paper (in the author's absence), made a less than scholarly remark about Tebbutt's conclusions and a pointed comment about the superiority of the Observatory's equipment. But any differences among members were far outweighed by what bound them together: family ties, professional connection, class. Something else they had in common was gender.

Women and the Royal Society are the subject of a separate chapter. There was nothing in the Society's original rules that excluded women; it was simply assumed that membership would be exclusively male. This had been consistent with contemporary cultural norms. Nevertheless, there were a few talented women who managed to exert some influence on the Royal Society's proceedings. Harriet Morgan and Helena Forde, daughters of Alexander Walker Scott, were knowledgeable entomologists and talented botanical artists. Helena provided illustrations for a paper on oology read before the Royal Society in 1865 by her cousin Edward Pierson Ramsay.[8] Both sisters later illustrated his book on that subject.

Between 1893 and 1914 the names of five other women, appeared as joint or sole authors of papers published in the Royal Society's *Journal*. In each case their papers were read out for them, and in their absence, by a Society member. Florence Martin was the daughter of a former premier of NSW. She assisted physicist Richard Threlfall with his research at the university and was his co-author on two papers published in the *Journal* in 1893 and 1897 respectively.[9] Fanny Cohen graduated from Sydney University with First Class Honours and the

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7 See the paper on Hirst by Lomb, Orchiston, and Jacob in this issue. [Ed.]

8 Ramsay, Edward Pierson. On the oology of Australia, read to the Philosophical Society of N.S.W., 5 July 1865, in *Trans. of the Philosophical Society of N.S.W. 1862–1865* 309–329. https://www.biodiversitylibrary.org/part/345638

9 Threlfall, Richard and Florence Martin. On an approximate method of finding the forces acting in magnetic circuits *J. & Proc. of the Royal Society of N.S.W.*, 27: 197–218, 1893, https://www.biodiversitylibrary.org/page/41687612#page/211/mode/1up ; and Threlfall, Richard and Florence Martin. A contribution to the study of oxygen at low pressures *J. & Proc.of the Royal Society of N.S.W.*, 31: 79–82, 1897, https://www.biodiversitylibrary.org/page/41844829#page/97/mode/1up

University Medal. In 1910, when employed as a university geology demonstrator, she was sole author of a Royal Society paper on azurite crystals.[10] In 1912, another university medallist and geology department demonstrator, Catherine Drummond Smith, published a paper jointly with her future brother-in-law, geologist Leo Cotton.[11] Jean White, a Melbourne university graduate and the second Australian woman to receive a Doctorate in Science, was co-author of a paper on Australian flora with botany Professor Alfred Ewart.[12] Mary Martha Everitt, Mistress in Charge of Girls at Parramatta Public School, collaborated with Royal Society member Robert Hamilton Mathews on a paper about the language and culture of Aboriginal people in south-east New South Wales.[13] A controversy regarding Mathews' contribution to this paper is discussed in the book.[14]

The Royal Society's Council's ongoing position on female membership was stated in 1880: "The rules only provide for the admission of … gentlemen as members; it is not customary for ladies to attend the ordinary meetings." Women were very welcome to attend the Royal Society's conversaziones, but other learned societies went further: Harriet Morgan and Helena Forde were made honorary members of the Entomological Society of NSW. The Royal Societies of Victoria and Queensland admitted their first female members in 1883 and 1889, and the Linnaean Society of NSW admitted botanist Sally Hynes in 1891. There was no equivalent development at the Royal Society of New South Wales. Even as membership continued to fall from the 1890s, there is no record of any formal discussion about admitting women. The Royal Society of NSW remained a gentlemen's club until 1935.

Much had been achieved in the Society's first 64 years. Apart from their gender blind spot, members had demonstrated a healthy capacity to embrace change. Radical reorganisation from the 1870s had been readily accepted, and, later, members were innovative in their efforts to retain and attract members. As I say in the book, this proven ability to respond to challenges was likely to serve the Society well in the years ahead.

10 Cohen, Fanny. Notes on the azurite crystals from Broken Hill, *J. & Proc. of the Royal Society of N.S.W.* 44: 577–583, 1910. https://www.biodiversitylibrary.org/page/41916492#page/709/mode/1up

11 Smith, Catherine Drummond and Leo Arthur Cotton. Some crystal measurements of chillagite, *J. & Proc. of the Royal Society of N.S.W.* 46: 207–219, 1912. https://www.biodiversitylibrary.org/page/41676580#page/243/mode/1up

12 Ewart, Alfred James and Jean White, assisted by J. R. Tovey. Contributions to the flora of Australia, *J. & Proc. of the Royal Society of N.S.W.* 42: 184–200, 1908. https://www.biodiversitylibrary.org/page/41579693#page/218/mode/1up

13 Mathews, Robert Hamilton and Miss Mary Martha Everitt. The organisation, language and initiation ceremonies of the Aborigines of the south-east coast of N. S. W. *J. & Proc. of the Royal Society of N.S.W.*, 34: 262–281, 1900. https://www.biodiversitylibrary.org/page/41821708#page/294/mode/1up

14 See also: Christopher R. Illert. The centenary of Mary Everitt's "Gundungurra" grammar. *J. & P. of the Royal Society of N. S. W.*, 134: 19–44, 2001. https://www.biodiversitylibrary.org/page/46349409#page/21/mode/1up

Foreword by Susan Pond

The Royal Society of New South Wales is a vibrant organisation active in the intellectual life of twenty-first century Australia.[15] In this book, Dr Anne Coote provides the very first comprehensive account of the early history of the RSNSW and its antecedents — from the mid-nineteenth century to the beginning of World War I. It is mandatory reading for any current or future member of the Society. Even though this time span and the Society itself embody a sliver of the record of human intellectual achievement, it is important to understand how and why it was conceived and developed, what it achieved for Australia, and how it is viewed now through the eyes of a cultural historian living in the third decade of the twenty-first century.

Dr Coote has created a very readable account that is hard to put down. By using the characters involved in the Society to tell its story, she has produced a rollicking recital of their lives and times, of the Society's fortunes and misfortunes, ebbs and flows, highs and lows. The storytelling is compelling not only because of her expertise as an historian and author but also her expansive and deep research during the past ten years. To paraphrase Anne's own words, her research rapidly became all-consuming, involving close study of the Society's extensive archives, and other primary and secondary sources, and taking more than six years of her working life. She dedicates the book to her late husband Robert Coote, a science graduate with a keen interest in mathematics and its history who, she says, "unselfishly accepted my day-long absences either in Sydney at the Mitchell Library or spent closeted in my study writing and rewriting."

As President of today's Society, I was gripped by a time-travelling sensation as I read the book. So many echoes of the Society's past still reverberate in the Society's Act and Rules and through the recurring issues on our Council agenda. These include: clarifying and communicating the purpose and value of the Society in our ever-changing world; delivering unique value to members and the broader public; understanding the motivations of members to join and contribute; overcoming the challenges of small financial reserves; having no fixed premises; preserving and making our extensive library and archives accessible; and maintaining the energy and enthusiasm of our volunteer workforce. We still hold general meetings on the first Wednesday of each month in Sydney; we continue to publish and exchange the Society's *Journal & Proceedings* with libraries across the world. We are the first colonial society to honour scientific achievement with a bronze medallion and we still award the Clarke Medal and strike it using the original 1876 design that bears a portrait of Clarke with his flowing beard. We also still use the Seal of the Society that was first designed by our late-nineteenth century reformist Archibald Liversidge, albeit modified to remove the words "Founded in 1821. Incorp. 1881."

The Society's claim of a foundation date of 1821 is a tension that Dr Coote confronts in Chapter 1. Centennial celebrations were held by the Society in 1921–22, followed by

15 Reprinted from A Coote, *Knowledge for a Nation*, pp. ix–xiii.

a spirited series of Bicentennial celebrations in 2021–22. The short-lived Philosophical Society of Australasia, founded in 1821, has long been the Royal Society's initial inspiration, but, as Anne argues, nothing of substance supports the Society's claim for lineal descent from that body. Rather, she identifies as the Royal Society's earliest antecedent, the equally short-lived Australian Society for the Encouragement of Arts, Science, Commerce and Agriculture, formed in 1850. This body's remaining funds and a fair proportion of its membership were absorbed into a new society formed in 1856: The Philosophical Society of New South Wales. This organisation changed its name to the Royal Society of New South Wales when it gained Royal Assent in 1866.

Dr Coote recounts how and why the Society reformed and prospered during the later decades of the nineteenth century under the leadership of its Honorary Secretaries, Archibald Liversidge and Carl Adolph Leibius, and with the support of other leading members such as William Branwhite Clarke (until his death in 1878) and Government Astronomer, Henry Chamberlain Russell. It continued its dominant focus on science applicable to local colonial issues; led increasingly by scientifically trained professionals instead of expert amateurs. Papers at meetings or published in the *Journal* covered topical branches of science, such as development of a flying machine, weather and water supply, geology, mineralogy and astronomy, along with the language and customs of Aboriginal people, who were erroneously thought to be doomed to extinction.

The Society's website today has links to all issues of the *Journal* and will soon publish its digital Bicentennial Bibliography that traces the timeline of the Society's publications to 2021 and author-alphabetically lists most of our historical papers, including links to online facsimiles. As a companion research guide, the Society has also compiled brief profiles of the professional careers and major achievements of most of the 118 men, and all three women, who have held the gavel at meetings of the Society and its antecedents since 1821.

Dr Coote highlights a small number of talented women whose research papers were presented before the Society and thereby contributed to the published history of science, despite being excluded from Society membership because of their gender. Florence Martin, for example, contributed papers on magnetic circuits and the study of oxygen, and Mary Everitt successfully submitted her research on the language and customs of Aboriginal people in south-east New South Wales. Helena and Harriet Scott, artists and expert entomologists, provided illustrations for the published work of Society members Edward Pierson Ramsay and Gerard Krefft. Nothing in the rules explicitly excluded women from membership. It was simply assumed that women had no place in such an organisation. Papers by these women were presented for them, in their absence, by a Society member. As Dr Coote remarks: "However scientific its goals, the Royal Society of New South Wales remained a gentlemen's club. Women would not be allowed to join it until 1935."

However, women were encouraged to attend the splendid conversazione events which from 1879 were usually held in the Great Hall of the University of Sydney. Each Ordinary member of the Society was allowed to bring two female relatives. In November 1879, the *Australian Town and*

Country Journal depicted on its cover the lively crowd attending the first RSNSW conversazione in the Great Hall, with a large number of women present. Conversaziones, special meetings "at which self-improvement merged with entertainment and pleasant social interaction," were fashionable, well-attended events that displayed innovations in science and technology to a wide audience, and enhanced the Society's "public image as a leading learned body that was up to date."

More than 50 interesting images illuminate the text of this book. We thank the State Library of New South Wales and its recently retired Director, Dr John Vallance AM, for its welcome support in scanning and donating many of them. The University of Sydney Archives was similarly generous with images from its collection. I acknowledge and thank John Hardie AM who as a former President and long-serving Council member commissioned Dr Coote to write this book. But it would not exist in published form without the expertise and dedication of a current councillor, Dr Davina Jackson, who has guided this book through the editorial and publication processes. Finally, the Society acknowledges financial support for this project from Create NSW's Cultural Grants Program, a devolved funding program administered by the Royal Australian Historical Society on behalf of the New South Wales government.

Knowledge for a Nation: Book Review by Peter Shergold

Once, long ago, in a faraway place, I was a historian. I got paid for imagining myself to be somewhere else. I had a sense of what it was like to grimace before the searing heat of a Bessemer converter, in the Carnegie mills in Pittsburgh in the 1890s, pouring molten steel into girders. In my mind's eye, I could see myself in the demeanour of a young man facing transportation to NSW, as he stood meekly before a judge at the Salisbury assizes in the 1820s, hearing himself found guilty of riot and affray, as his distraught wife, babe in arms, wept loudly in the public gallery.

I knew at first hand the pleasure of being in another world and trying to understand it. I shared the view that the novelist, LP Hartley, set down so memorably in his 1953 novel, *The Go-Between*: "The past is a foreign country: they do things differently there." I loved visiting.

Pick up this wonderful and engaging history by Dr Anne Coote, and you, too, will find yourself in a different place. You will be transported to another time, listening in on vigorous debates about science, technology, medicine, philosophy and society. More importantly, you will gain a sense of the world which shaped their views and their approach to intellectual discovery.

At one level this is a history of bewhiskered men, striding the colonial landscape with pompous self-assurance. It probably does not surprise us that these Fellows would not allow women to become members of their Society, even though it had been made Royal only by the Assent of Queen Victoria. As time went on the men, in a curt nod to the intellectual contribution of the "fairer sex," would allow a few women to submit papers on the condition that they were read out on their behalf by one of their male colleagues.

In a sense this is a world we think we know through the popular depictions presented in novels, theatre, films, television and — increasingly popular — history podcasts. Through the swirling fog and dim gas lamps of countless movies we have glimpsed streets lined with horse-drawn carriages and heard the rustle of crinoline petticoats.

Yet, because of Coote's wonderful attention to just the right detail, we are allowed to comprehend the world that existed behind the memes. We come to understand the sense of self-improvement, scientific inquiry and genuine wonderment that drove the desire of colonists and founding fathers of the nation to meet in the Philosophical, Australian and Royal Societies; to pay fees commensurate with their status; and to write and publish papers for posterity.

It was not always intellectual ferment. Many meetings were so poorly attended that the Societies struggled to survive. In marked counterpoint, there were also glittering Conversaziones that were held on a grand scale (one, held in the Great Hall of Sydney University on 8 October 1884, provides a fine front cover to the book). In refined elegance, attendees would celebrate the contribution of intellectual endeavour to their shared belief in the untrammelled agricultural, industrial and cultural progress of a "new" land. To grace such occasions, each Fellow was allowed to invite two female relatives.

Here, then, in the words of Susan Pond in her Foreword, is no dry-as-dust cultural history but rather "a rollicking recital … of the Society's fortunes and misfortunes, ebbs and flows, highs and lows." It is a compelling story. Through these pages we meet the inspired amateurs (avidly collecting their fossils, beetles and plants); the emerging professionals (astronomers, surveyors, geologists, botanists and engineers); and, by the end of the 19th century, and in a sign of times to come, the academics.

They varied in character and intellectual capacity. Some were competitive and fiercely protective of their research. Others were more open in their approach to inquiry. Coote centres her history of the scientific establishment on the flesh, blood and temperament of the participants, not just on the ideas that they espoused. We meet real people, some snooty, some engaging, some dull, some respectable, some downright unethical but, nearly all of them, insatiably curious or at least feeling the need to behave so in front of others.

Such a colourful narrative should be enough to ask of a history of the emergence of the Royal Society of New South Wales. But between the covers of this absorbing book lies something else. History is more than a travel guide to a foreign country. In the words of another great novelist, the black American author, James Baldwin: "People are trapped in history and history trapped in them." History is not just a quaint place to visit. It has made the world in which we live today and beckons to the future which awaits.

In the view of an increasing number of Australian historians, the world that frames much of Coote's book — colonial society — has become embedded in a "colonialist" mentality that continues to permeate contemporary Australian society. It is argued that the ideas espoused by these pillars of the scientific and philosophical community more than a century ago help to explain the cultural assumptions that prevail today. The commitment to the European exploitation of a "new" country that underlay so many

of the activities of the Royal Society is now increasingly denounced by critics in terms of invasion, disposition and subjugation.

Aboriginal Australians have led the way in demanding that truth-telling about our history needs to be central to any meaningful reconciliation. And they are right. We need to look at our past with eyes wide open.

Understanding what motivated the members of the Royal Society is not a bad place to begin this task. Here are those — many, literally, colonists — who exemplified the Enlightenment values and progressive ideals of society, whilst holding fast to a range of deep-seated prejudices about racial and cultural differences. The book inspires one to go beyond the text and to follow the footnote trail.

Thanks to Coote, I discovered that the first paper to the newly formed Philosophical Society was to be presented by the surgeon and merchant, Alexander Berry. However, he was called upon to make an exploratory voyage to Batemans Bay and so the NSW Supreme Court Justice, Barron Field, stepped in.[16]

Field was a plump man who exuded a friendly demeanour although, in common with many of his counterparts, he was prone to fits of irascible jealousy on occasion. He made a major contribution to identifying new species of plants in NSW. Even today, one will often find the abbreviation, **B. Field**, in botanical literature. But his talk on this occasion was not about *Boronia anemonifolia*. Rather he took the opportunity to present his assessment of the "Aborigines of New Holland and Van Diemen's Land." His talk was delivered on 2nd January 1822.[17] I have now read that paper. It was discomforting.

Field hypothesised that the colony's Aboriginal people were of Ethiopian origin. They were an inferior human species of degenerate character, not able to be civilised by any act of kindness by the newcomers. The local native peoples whom he had studied were, to his mind, barbarous savages, unashamed by their nakedness.

Field, who had met William Wordsworth, and took immodest pride in his banal poetry, concluded his address:

> As in the eye of Nature he has lived
> So in the eye of Nature let him die.

That supposedly rationalist view, presented by a founding member of the Philosophical Society, is a confronting truth to face. But it is not the only truth. For, between 1821 and 1914, Society members sought on numerous occasions to understand the social structures, languages and cultures of the Aboriginal peoples with whom they had contact. The history, anthropology and societal treatment of Aboriginal peoples was a place of contested views and varied emotions.[18]

Most members shared Field's view that the continent's Indigenous people were doomed to extinction. However, whilst many accepted that conclusion with equanimity (and turned a blind eye to frontier wars and massacres), others, genuinely fascinated by Aboriginal cultures, were dismayed. There was a sense of loss. "Would that we had a record of what they really are before they

16 See Clemens, 2018. [Ed.]

17 See Field (1825).

18 Readers might be interested to peruse the collection of papers on Aboriginal themes in the Society's publications from 1822, at https://www.royalsoc.org.au/aboriginal-html/ [Ed.]

pass away from among us," concluded John Fraser, a headmaster from Maitland whose book, *The Aborigines of New South Wales*, won the Royal Society prize in 1882.

The amateur ethnologist, Robert Hamilton Mathews, was the Royal Society member who probably exhibited the most compulsive interest in Aboriginal culture. He published no fewer than 27 papers in the *Journal of the Royal Society* between 1893 to 1911. He was a dedicated researcher. Or perhaps not. Thanks to Coote, we also know that Mathews stands accused of stealing the intellectual property of others and presenting it as his own; routinely falsifying his field notes; and acting for his own pecuniary gain in his role as surveyor. He was a deeply flawed character.

Perhaps a more impressive witness to Aboriginal life was Mary Martha Everitt, the Mistress-in-Charge of Girls at the Superior Public School in Parramatta. Everitt, an admirer of Aboriginal culture, who talked to them extensively, almost single-handedly preserved much of the Gundungurra language for posterity. She was able to have her research presented to the Society by Mathews in 1900. Mathews published her paper as his own in the *Proceedings of the American Philosophical Society* the next year.[19] True to form, he gave no acknowledgement of Everitt's research.[20]

For these insights, and many others, I am delighted that *Knowledge for a Nation* has been written. But, in truth, this thoughtful and readable history could have been aptly titled *Knowledge of a Nation*. It marks an important contribution to understanding the hopes and disappointments, conflicts and camaraderie, challenges and achievements of the intellectual leadership of NSW, as the Society's members sought to transplant the latest ideas from Europe to Australia. To a significant extent their views of the world seem a foreign place, yet many of their collective values continue to permeate the institutional and political structures of contemporary Australian society.

It is for that reason that it is imperative that we understand our history. We need to tell its truth with honesty. But Coote's book, through its accumulated detail, shows that there was no single colonial truth. Ideas, social as well as scientific, were fiercely argued.

We need to embrace the demand of First Nations peoples for truth telling. But, in doing so, we need to remind ourselves that not only will the quest for truth always rely on conflicting interpretations of empirical evidence, but that in the 19th and early 20th centuries — as in 2024 — people (with very different perspectives) argued fiercely about the ideas that framed their view of the world and the society that they wish to create. Coote's history reminds us that the past was a place of contested truths. So will be the history by which that tale is told.

I recognise the foresight of John Hardie, former President of the Royal Society, who commissioned this history. I pay tribute to Davina Jackson who has worked tirelessly in recent months, leading the editorial and publication processes. It was a mighty effort.

But most of all I extol the energy and intellectual rigour that Anne Coote has

19 See Mathews (1901).

20 See Illert (2001).

brought to this history. It represents years of work, often at significant personal cost. I hope that she knows that it has been worth it.

To potential readers — Royal Society members and beyond — I thoroughly recommend this book. Buy it. Read it. Think about it.

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Shakespeare on politics — what can we learn?

John Bell AO OBE DistFRSN[1]

Bell Shakespeare Company, Sydney

Welcome from the Governor, Her Excellency, the Honourable Margaret Beazley AC KC

Bujari gamarruwa Diyn Babana Gamarada Gadigal Ngura

In greeting you in the language of the Gadigal, Traditional Owners of these lands and waterways, I pay my respects to their Elders past, present, and future. I extend that respect to the Elders of all parts of our State from which you have travelled.

There are moments in one's life when an event so concentrates the mind that it is forever fixed in one's consciousness. For some it was JFK's assassination. For others, September 11. Often it is a far less dramatic moment.

For me, one of the latter occasions was the first time I heard John Bell do a reading of Shakespeare. I remember exactly where it was — a dinner at the University of Sydney, in the late 1970s. So transfixed was I by the delivery that, as I speak, I cannot quite bring to mind the piece he delivered. But I was hooked, if not on all of Shakespeare at that time, certainly on any of John Bell's performances.

It was his vision that brought into our midst the Bell Shakespeare Company, which over its nearly 35-year history has matured into a premier arts institution and a leading Shakespearian performance company. We are blessed.

But why is this important? Indeed, why is Shakespeare even relevant some four centuries after his plays were written and performed. This is probably a rhetorical question, given the number of biographies of Shakespeare, the books written about his works, what must be the millions of performances of his plays.

Shakespearian scholar Harold Bloom sees Shakespeare as not a mere observer of the human condition, but as the inaugurator of that condition in the first place. In his 1998 work *Shakespeare: Inventing the Human*, Bloom wrote: "Shakespeare will go on explaining us, in part because he invented us."[2]

Thus, when in 1891 Oscar Wilde wrote that "Life imitates art far more that art imitates life,"[3] he was, I would suggest, echoing Jacques in *As You Like It*, in one of Shakespeare's most quoted observations: "All the World's a Stage And all the men and women merely Players."[4]

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1 Edited transcript from a talk presented on March 6, 2024, at Government House, Sydney, as part of *Ideas@theHouse*. John Bell became a Distinguished FRSN in 2024. https://www.youtube.com/watch?v=-VO07eEpIpk

2 Bloom H. (1998), *Shakespeare: The Invention of the Human*, New York, Riverhead Books, p.20.

3 Wilde O. (1891), The Decay of Lying, in *Intentions*.

4 *As You Like It* (1599) (Act 2 Scene 7 Lines 139–140). The motif of the world-as-stage is repeated in several other of Shakespeare's plays: "Life's but a walking shadow and he himself nothing but a poor player that struts and frets his hour upon the stage" (Macbeth, Act 5 Scene 5); "I hold the world but as the world, Gratiano; A stage where every man must play a part, And mine a sad one" (*The Merchant of Venice*, Act 1 Scene 1). Although emblematic

Coming from a melancholic ruminator, as Jacques is, this soliloquy draws the listener into what seems to be a mediation on the misery of life; after all, none of the ages of man he then runs through, comparing them to the acts of a play, sound much fun. Take old age: "with spectacles on nose and pouch on side" and the final age, one's dotage, "Sans teeth, sans eyes, sans taste, sans everything." And *As You Like It* is one of Shakespeare's comedies.

I first found my Shakespeare home in his comedies, probably as an antidote to studying *King Lear* (1605–06) — one of his three great tragedies — at school. The other two are, of course, *Macbeth* and *Julius Caesar*, in which we find Shakespeare's unravelling of the human spirit cleverly crafted through language and history.

Take *Macbeth*, for example, which introduced the word "assassination" into the English language.[5]

In *Julius Caesar*, which was written at a time following a series of religiously motivated attempts on the life of Elizabeth, Shakespeare understood the power of brevity of language: "Et tu Brute".[6] Nothing more needed to be said.

Of John Bell, there is much to be said.

Tonight, we have the extraordinary privilege of hearing from an individual whose knowledge of Shakespeare's plays — both as text and, perhaps more importantly, as performance — is unequalled in this country. He has been pivotal in making accessible to countless audiences the rich experiences those plays provide. He established a company that has educated, enriched, and expanded our world.

I thought, however, that much could be understood of this consummate artist who has played such a seminal role in Australian theatre and in modern Australian thought by reference to his university friends and contemporaries, and his sometime housemates; the names are a litany of the movers and shakers of the 1970s in the arts, in literature, in journalism.

There were political activists and political commentators, including Clive James, Germaine Greer, Bruce Beresford, Ken Horler, Mungo McCallum (of whom it is reported Gough Whitlam described as "a tall, bearded descendant of lunatic aristocrats" — Gough did have a flair for the "magisterial statement"). There was also Richard Wherrett, John Gaden, Laurie Oakes, and Les Murray.

It might not be surprising, therefore, to find that the title of tonight's presentation, in what is the 9th iteration of *Ideas@theHouse*, held in collaboration with the Royal Society of NSW, is *Shakespeare on politics — what can we learn?*

Ladies and gentlemen: John Bell.

Introduction

Thank you very much, Your Excellency, and good evening, everybody. Well, I guess we were all quite happy to see the end of 2023. It was a pretty rough year. Apart from the record-breaking climate-change events all over the world — fires, floods, droughts, and pollution — we had the ongoing horrors of Russia's invasion of Ukraine and the ghastly

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of Shakespeare's work, the motif is not originally his, appearing in *Damon and Pythias*, a play by Richard Edwardes published the same year as Shakespeare was born.

5 Shapiro J. (2006), *1599: A Year in the Life of William Shakespeare*, London: Faber, p. 160

6 *Julius Caesar* (Act 3 Scene 1)

war in Gaza, which apparently has images too terrible to broadcast, let alone contemplate. And I'm afraid this year isn't looking a great deal better so far, plus we have the American elections coming up. So, buckle up. It could be a bumpy ride.

I don't know about you, but sometimes I wake up in the mornings and pause before I switch on the news, wondering "What new horrors await us? What is the latest thing we have inflicted on ourselves? What damage have we done? What aggression or torture or cruelty or abuse?" We really are a rotten species. Why don't we just drop the bomb and give the place back to the cockroaches?

But then I stop and think, "Hang on, we've also produced Socrates and Shakespeare, Mozart, Bach, and Beethoven. We have produced Isaac Newton and Einstein, Angela Merkel, Marie Curie, Stephen Hawking, Abraham Lincoln, Emeline Pankhurst, Martin Luther King, Mum Shirl, Eddie Mabo, Nelson Mandela, and Greta Thunberg, and that late great Russian patriot, Alexei Navalny. So, we aren't a lost cause after all." We have achieved wonderful things and we are capable of making a wonderful world. But, on dark days, the forces of ignorance, bitterness, hatred, and outdated ideology do seem about to overwhelm us.

We need heroes and heroines — inspirational figures who give us, by example, the courage and the will to carry on.

I have my own pantheon of such people, and I find they are usually risk-takers: people who have dared to break the mould, challenge tradition, and ask, "Why not?"

I find that many of my personal heroes are the ones who failed — who pushed the boundaries too hard, too soon. But their sacrifices have made breakthroughs possible. I think of Giordano Bruno, burnt at the stake in Rome, and Galileo, who was threatened with the same fate for defying the Church and declaring that the Sun, not the Earth, was the centre of our universe.

I think of poor Vincent van Gogh, who sold only one painting in his life — to his brother Theo, who felt sorry for him — the rest he couldn't give away. "Just give me the cost of the paint," he would beg, but no one wanted them. Today, of course, his paintings are worth millions of dollars. Not that the price tag is any proof of quality. It just shows that the world has at last caught up with van Gogh and now concedes the brilliance and originality of his vision.

I think of Georges Bizet, whose opera *Carmen* was booed off-stage at its premiere. The critics were outraged: "Operas should be about noble people with lofty sentiments. How dare you write an opera about a gypsy girl and her sordid affair with a toreador and a common soldier!" Bizet died a few months later of a broken heart, never to know that *Carmen* would be the most popular opera ever written.

I think of the courage and the doggedness of Ludwig van Beethoven, who started going stone deaf at the age of 26, but pressed on, turning out some of the greatest music of the Modern Age for the next thirty years, even though he never got to hear it. After conducting one of his great symphonies, he stood facing the orchestra and had to be turned around to see that the audience was on its feet and cheering.[7]

7 This was the premiere of his Ninth Symphony, two hundred years ago, on 7 May 1824, in Vienna, at a theatre since 1870 the site of the Hotel Sacher, home of the incomparable Sachertorte. https://weta.org/fm/classical-score/may-7-1824-200th-anniversary-premiere-beethovens-symphony-no-9 [Ed.]

William Shakespeare (1564–1616)

But of all the great artists I admire, the one who's had the greatest impact on my life and career is the dramatist and poet William Shakespeare, whom I first encountered as a 14-year-old schoolboy. Shortly after making his acquaintance, I declared, "I'm going to be an actor and perform Shakespeare for the rest of my life," which is more or less what I've done.

What is it about Shakespeare that inspires me? (Let's remember that the word "inspire" literally means "breathing in:" to open your mouth, to see something wonderful, and to breathe it in until it fills you — inspiration.)

Shakespeare's curiosity and insights

The first thing that inspires me about Shakespeare is his curiosity. He was a true Renaissance man, curious about everything — about Nature, about science, about history, art and politics, about the law and exploration, about language, but mainly about people.

He had an extraordinary insight into human nature and an empathy with people of all ages and social classes. Before Shakespeare, the characters in English drama were all stock figures and stereotypes: the young lovers, the smiling villain, the tyrant king, the noble hero etc. Shakespeare rejected such simplistic and fixed characters and said, "We're not determined by our star signs or by our chemical makeup — instead, we are a bundle of contradictions, conflicting urges, and impulses, predictable in nothing except our inconsistencies." The American academic Harold Bloom has attributed to Shakespeare the invention of "personality."[8]

Shakespeare could put himself with equal ease into the mind of a 14-year-old girl, a crazy old king, or a psychopathetic killer. He could identify with all of them.

As a schoolboy at Stratford Grammar, he was taught to debate in Latin and Greek, and plead either side with equal conviction — a great training for a dramatist. He could always see both sides of any moral dilemma.

But from early on, he developed a habit of taking sides with the underdog, the outsider. For instance, black people were unpopular in London at the time, equated with the Sons of Darkness, Sons of the Devil. Queen Elizabeth herself complained that, "Too many Negroes have crept into our kingdom."[9] Yet Shakespeare makes Othello his most sympathetic tragic hero, the victim of racial hatred and envy. Caliban, the so-called monster in *The Tempest* (1611),[10] is given the play's most poignant poetry. He loves the island that has been taken from him and is the only one to appreciate its beauty. A wave of anti-Semitism swept through London as the result of a trumped-up Jewish plot against the Queen.[11] Shakespeare's rival Christopher Marlow rushed into print with a vicious anti-Semitic play called *The Jew of Malta*, and Shakespeare quickly responded with the comedy *The Merchant of Venice* (1596–97),

8 Bloom (1998) Op. cit. [Ed.]

9 Bartels, E.C. (2006) Too many blackamoors: deportation, discrimination, and Elizabeth I, *Studies in English Literature, 1500–1900*, 46(2), Tudor and Stuart Drama: 305–322. [Ed.]

10 The plays' dates are taken from a Royal Shakespeare Company timeline. [Ed.]

11 See 28 February 1594 Trial of Rodrigo Lopez finds him guilty of plot to poison Queen Elizabeth I, https://jewinthepew.org/2015/02/28/28-february-1594-trial-of-rodrigo-lopez-finds-him-guilty-of-plot-to-poison-queen-elizabeth-i-otdimjh/ [Ed.]

in which a Jewish character is central to the play: Shylock, the money lender. But here the Jew is depicted as a victim of abuse and persecution, especially at the hands of Antonio, the Christian merchant.

When asked why he wants revenge on Antonio, Shylock replies:[12]

> He hath disgraced me and hindered me of half a million … Laughed at my losses, mocked at my gains, scorned my nation, thwarted my bargains, cool'd my friends, heated my enemies; and what's his reason? I am a Jew … Hath not a Jew eyes? Hath not a Jew hands, organs, dimensions, senses, affections, passions; fed with the same food, hurt with the same weapons, subject to the same diseases, healed by the same means, warmed and cooled by the same winter and summer as a Christian is? If you prick us, do we not bleed? If you tickle us, do we not laugh? If you poison us, do we not die? And if you wrong us, shall we not revenge? If we are like you in the rest, we will resemble you in that. If a Jew wrong a Christian, what is his humility? Revenge. If a Christian wrong a Jew, what should his sufferance be? By Christian example? Why — revenge. The villainy you teach me, I will execute; and it shall go hard but I will better the instruction.

Whatever our sympathy for Shylock, we know that revenge is not the answer. We can see by what's happening in Gaza that revenge only begets revenge.

Refugees were also unwelcome in London, flooded with Huguenots fleeing Catholic persecution in France. They were met with hostile crowds and the old familiar chant: "They've come here to take our jobs!" There were violent demonstrations and attacks on the hapless refugees.[13] Shakespeare addressed the issue in his play *Sir Thomas Moore* (1592–95) (Act 2 Scene 4). This speech is of great significance, not only for its content, but because it's the only surviving page of manuscript we have in Shakespeare's own hand. [Figure 1] Sir Thomas Moore confronts the rioters who want all the so-called "strangers" removed from England:[14]

> Grant them removed and grant that this your noise
> Hath chid down all the majesty of England;
> Imagine that you see the wretched strangers,
> Their babies at their backs, and their poor luggage
> Plodding to the ports and coasts for transportation.
> And that you sit as kings in your desires,
> Authority quite silent by your brawl,
> And you in ruff of your opinions clothed.
> What had you got? I'll tell you: you had taught
> How insolence and strong hand should prevail,
> How order should be quell'd, and by this pattern
> Not one of you should live an aged man;
> For other ruffians, as their fancies wrought
> With self-same hand, self reason, and self-right,
> Would shark on you, and men like ravenous fishes
> Would feed on one another.
> What country, by the nature of your error,
> Should give you harbour?

12 *The Merchant of Venice* (Act 3 Scene 1)

13 On Evil May Day, May 1, 1517. [Ed.]

14 Watch Sir Ian McKellen declaim the "Strangers'" speech, https://www.williamlanday.com/2017/02/28/shakespeares-speech-on-immigrants/ [Ed.]

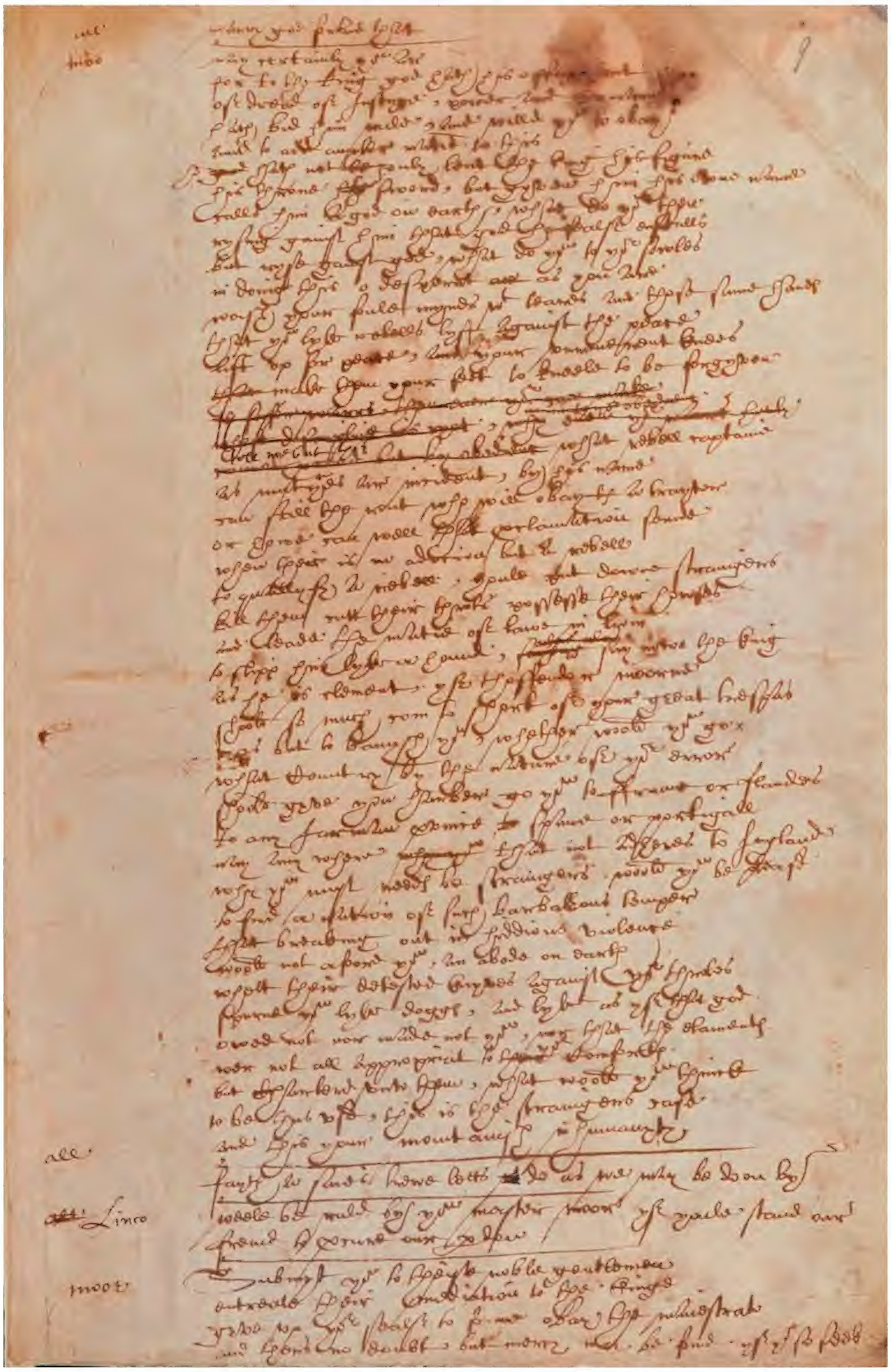

Figure 1: The "Strangers' Case" speech in Shakespeare's own hand; the only surviving page of his writing. In the British Museum.[Ed.]

> Why, you must needs be strangers!
> Would you be pleased
> To find a nation of such barbarous temper
> That, breaking out in hideous violence,
> Would not afford you an abode on Earth?
> Whet their detested knives against your throats,
> Spurn you like dogs; what would you think
> To be such used? This is the strangers' case
> And this your mountainish inhumanity.

A speech very pertinent to our times, I think, as we see far-right candidates in Germany and the USA promising to deport asylum seekers.

Shakespeare's range

The second aspect of Shakespeare that most inspires me is the range of his work. Most of us can write one sort of book or play — you'll know what I mean by "a typical Agatha Christie or Stephen King," — even "a typical Noël Coward or Tennessee Williams." But there's no such thing as "a typical Shakespeare." Of his 38 surviving plays, there aren't two alike. He wrote tragedies, comedies, romances, historical dramas, knockabout farces, and magical fairy tales. Even within those genres no two plays are alike. Each of his comedies, for instance, stands alone and bears no resemblance to any of the others in tone or expression.

This is a tribute to his wide-ranging imagination: not only could he imagine a moonlit forest, a blasted heath in Scotland, a sunny forest of Arden, a freezing castle in Denmark, or a fantasy island in the Caribbean, he could bring them all to life without scenery in broad daylight on the open-air stage of the Globe and people would believe him:

> "Ill met by moonlight, proud Titania!"[15]
>
> "The air bites shrewdly; it is very cold."[16]
>
> "But, look, the morn in russet mantle clad,
> Walks o'er the dew of yon high eastern hill."[17]

Shakespeare's imagination

And so on. Shakespeare's imagination fired the imaginations of the two thousand people packed into the Globe, and they went on his journey with him.

Imagination is the prime driver of all successful enterprises. I recall an interview with Paul Keating, in which he said, "If you can't imagine a new *economic* landscape, if you can't imagine a new *social* landscape or *international* one, then there's no way you're going to get one. In the end, if the creativity is not there, if the artistry is lacking, the outlook will be meagre and dull."

Art, music, poetry, and drama — these are the elements that nourish our imaginations, which otherwise would lie dormant.

And what fires imagination? It's a sense of wonder, as if seeing things for the first time, the way a child does. We all know the delight of watching a child experience something wonderful for the first time — a Christmas tree, a birthday present, a new puppy, a trip to the circus. Wide-eyed and open-mouthed, they breathe it in: Inspiration.

We take joy in seeing them have that experience, and it may remind us that we've become somewhat jaded or nonchalant, in taking such things for granted. We've seen it all before.

An artist is somebody whose sense of wonder, of seeing things as if for the first time, is not jaded, doesn't become nonchalant, but is constantly alert to the beauty or the horror, the absurdity and the bliss, the miracle of everyday life. If we keep an open mind and an open heart, we can share that experience and see life anew through the eyes of the artist.

Was Shakespeare a risk-taker?

Was Shakespeare a risk-taker? He certainly was. Sometimes his dabbling in politics came too close to the bone. His play *Richard II* (1595–96) showed a weak monarch being

15 *A Midsummer Night's Dream* (1595–96) (Act 2 Scene 1).

16 *Hamlet* (1600) (Act 1 Scene 4).

17 *Hamlet* (Act 1 Scene 1).

deposed by his feisty cousin. It struck a nerve with Queen Elizabeth, who was being threatened by *her* cousin, Mary Queen of Scots: "Know you not," she stormed, "that I am Richard the Second?" The play was banned, and Shakespeare and his fellow actors were called before a tribunal. Some fast talking by friends at Court saved his neck.

His rival Ben Johnson castigated him for breaking the rules of classical theatre, which prescribed that a drama should take place in real time, in the one location, like the ancient Greek Tragedies. But Shakespeare flouted the rules by having the action take place on multiple occasions, sometimes over large gaps in time, thus revolutionising the whole nature of drama. All of Shakespeare's plays are still regularly performed; Ben Johnson's only rarely. Shakespeare's whole career was one of experiment, revolution, and breaking the rules, challenging his audience.

Shakespeare and leadership

Over a lifetime spent working in the theatre, founding and running two theatre companies, I've learnt quite a lot about leadership from studying Shakespeare's plays and characters. *Julius Caesar* (1599) is a virtual playbook of the dos and don'ts of leadership. In the play's tussle for leadership, we can see why some succeed and others fail.

Take Julius Caesar himself: a brilliant military commander, a crafty, ruthless politician, great orator, who's undone by overweening ambition. His arrogance and aloofness mean that he's not moving with the times. He has a tin ear and can't hear the signs of conspiracy happening all around him. He allows flatterers to steer him away from reality and refuses to listen to sound advice.

His antagonist Brutus may be "the noblest Roman of them all," but he too has his flaws. Proud of his reputation for honesty and integrity, he has no tolerance for weakness in others and dismisses their opinions. He is too secure in his opinion of himself.

His friend Cassius, on the other hand, is too lacking in self-confidence and allows himself to be overruled by Brutus, even when he knows that Brutus is wrong.

Mark Antony is a brilliant spin-doctor and a manipulator of public opinion — a supremely tricky orator. But having got the top job, he whittles it away through self-indulgence and laziness. It's not enough to get to the top job; you have to have the flexibility and the self-control to stay there.

Coriolanus is another instructive figure from Roman history. A brilliant fighting machine, he is a nightmare in peacetime: a man who refuses to compromise or negotiate, and so is easy pickings for the politicians who seek to destroy him. General George Patton springs to mind.[18]

Shakespeare's eleven history plays give us more graphic examples of good and bad leadership. We witness the destruction of Richard II, who puts his faith in divine right and entitlement.

We see the demise of his successor, Henry IV, who is plagued with guilt for the murder of his predecessor, and believes that the proper posture for a king is aloofness and austerity. He makes a major mistake by being ungrateful to those who have helped him attain the Crown, thereby breeding resentment and rebellion.

18 See the discussion of Coriolanus the character in Greenblatt, S. (2018) *Tyrant: Shakespeare on Power*, London, Bodley Head. [Ed.]

His son, Henry V, is the most charismatic and successful of Shakespeare's monarchs. He has learned by watching his father's mistakes and sets about crafting his image from an early age. He has spent his adolescence in London's pubs and brothels, partly so that he may dazzle the world by his eventual "reformation," but also so he may get to know the people he will eventually reign over. He wants to know their names, how they live, what they think. He's adept at developing "the common touch."

As soon as he is king, he sets about making himself a national hero by declaring war on France and blackmailing the Church into giving him its blessing.

At first, his campaign goes well, with Henry exhibiting such sterling leadership qualities as tenacity, endurance, strategic thinking, discipline, and a contagious optimism. But as he advances deeper into French territory, his troops are beset by illness, fatigue, and depletion in numbers.

He gets as far as Agincourt, where he finds himself outnumbered five-to-one by a French army, fit, well-armed, and itching for battle. And this is where Henry's true leadership comes to the fore. He realises that stirring speeches and grand rhetoric aren't going to win the day. He is adept at reading the room and changing tack. He has to find a language that is homely and simple. He has to call his troops by name and convince them that they are a band of brothers, and they are actually lucky to be here to participate in such a glorious victory. He can't offer them reinforcements or full bellies or warm coats. He can offer them something better — immortality.

This day is call'd the feast of Crispian:[19]
He that outlives this day, and comes safe home,
Will stand a-tiptoe when this day is nam'd,
And rouse him at the name of Crispian.
He that shall live this day and see old age
Will yearly on the vigil feast his neighbours,
And say 'Tomorrow is Saint Crispian:'
Then will he strip his sleeve and show his scars
[And say 'These wounds I had on Crispin's day'.]
Old men forget: yet all shall be forgot,
But he'll remember, with advantages,
What feats he did that day. Then shall our names,
Familiar in his mouth as household words —
Harry the King, Bedford and Exeter,
Warwick and Talbot, Salisbury and Gloucester —
Be in their flowing cups freshly remember'd.
This story shall the good man teach his son;
And Crispin Crispian shall ne'er go by,
From this day to the ending of the world,
But we in it shall be remembered;
We few, we happy few, we band of brothers —
For he today that sheds his blood with me
Shall be my brother; be he ne'er so vile,
This day shall gentle his condition.
And gentlemen in England now a-bed
Shall think themselves accurs'd they were not here,
And hold their manhoods cheap whiles any speaks
That fought with us upon Saint Crispin's day.

And the rest, of course, is history. The speech works its magic and Henry's troops go on to win one of the greatest military victories in English history.[20]

Having spent the bulk of my life running two theatre companies — the Nimrod

19 *Henry V* (1599) (Act 4 Scene 3).

20 On 25 October 1415. [Ed.]

and then Bell Shakespeare — I reckon I've learned a lot of valuable lessons about leadership by studying Shakespeare's plays and characters. These lessons include listening to people, empathising with their situations, not taking myself too seriously, leading from the front, but as part of the team, staying loyal, trustworthy, resilient, positive, optimistic, generous with praise, and grateful for support, bold, but responsible in risk-taking.

I don't say I've always succeeded in all of the above, but at least I know the lessons are there to be learned.

Shakespeare's longevity

Shakespeare's plays have lasted 400 years and are still performed the world over in almost every language. One reason they've lasted so long is that in a sense, they remain unfinished. Shakespeare asks lots of searching questions in his plays but he doesn't provide any answers. The plays never have a so-called message. They're never didactic, unlike Berthold Brecht's or George Bernard Shaw's, and many playwrights writing today with a particular social or political agenda.

That means that each generation has to answer Shakespeare's questions in its own way: what do we think about racism? Anti-Semitism? Sexism? The Patriarchy? Ambition? Revenge?

The words remain the same. The words are the text, but the text is not the play. The play is what happens when actors pick up the text and start to perform it to each other.

And that's where the answers, the attitudes, the responses will become manifest. The words are always the same, but the play is always different, always new, always now.

Shakespeare's language

And then we have language. Language is humankind's greatest invention. That which separates us from, and allows us to dominate, the rest of the animal kingdom. English has been the most successful to date of all the modern languages, and Shakespeare was one of those who shaped the English we speak today.

English, more than most languages, is always in transition. New words and phrases are added to the lexicon every day, and other words and phrases become obsolete. In Shakespeare's day, the English language was experiencing a major explosion of invention and excitement. There was as yet no definitive English dictionary,[21] so words could be new-minted and mean whatever you wanted them to mean, especially with such a wide range of English dialects and accents. Most of us today have a vocabulary of about 10 to 20,000 words. Shakespeare had a vocabulary of some 60,000 words and introduced hundreds of new words and phrases into our language.

We quote him all the time without realising it. In the words of Bernard Levin:

> if you cannot understand my argument and decide "*It's Greek to me*," you are quoting Shakespeare. If you claim to be *more sinned against than sinning*, you are quoting Shakespeare. If you recall your *salad days*, you are quoting Shakespeare. If you act *more in sorrow than in anger*, if your *wish is father to the thought*, if your *lost property* has *vanished into thin air*, you are quoting Shakespeare. If you have ever refused to *budge an inch* or suffered from *green-eyed jealousy*, if you've been ever *played fast and loose*, if you have been *tongue-tied*, a *tower*

21 Reputed to be Samuel Johnson's *Dictionary of the English Language* (1755). [Ed.]

of strength, *hoodwinked*, or *in a pickle*, if you have *knitted your brows*, made a *virtue of necessity*, insisted on *fair play*, *slept not one wink*, *stood on ceremony*, *danced attendance* (on your lord and master), *laughed yourself into stitches*, had *short shrift*, *cold comfort*, or *too much of a good thing*, if you have *seen better days*, or *lived in a fool's paradise* — why, *be that as it may*, *the more fool you*, for it's a *foregone conclusion* that you are, as *good luck would have it*, quoting Shakespeare.

If you think that it's *early days* and you clear out *bag and baggage*, if you think it's *high time* and *that is the long and the short of it*, if you believe that *the game is up* and that the *truth will out*, even if it involves *your own flesh and blood*, if you lie low to the *crack of doom* because you suspect *foul play*, if you set your *teeth on edge*, *at one fell swoop*, without *rhyme or reason*, then, to *give the devil his due*, *if the truth were known* (for *surely you have a tongue in your head*) you are quoting Shakespeare, even if you *bid me good riddance* and *send me packing*. If you wish I was as *dead as a doornail*, if you think that I am an *eyesore*, a *laughing stock*, the *devil incarnate*, a *stony-hearted villain*, *bloody-minded*, or a *blinking idiot*, then — *by Jove*! *O Lord*! *Tut, tut*! for *goodness' sake*! *what the dickens*! — *it's all one to me* — for you are quoting Shakespeare.

That was Bernard Levin's doing, not mine.[22]

Shakespeare and governance

Apart from Shakespeare's comments on leadership, which I spoke of above, what does he have to offer about when it comes to good governance and the safety of the realm?

In *Henry V*, the Archbishop depicts a medieval concept of order, with the king at the top and everyone else one step rather below on the ladder, each one fulfilling a function allotted to him at birth.[23]

> Therefore doth heaven divide the state of man into diverse functions,
> Setting endeavour in continuous motion;
> To which is fix'd as an aim or butt
> Obedience; for so work the honeybees,
> Creatures that by a rule in nature teach
> The act of order to a peopled kingdom.
> They have a King, and officers of sorts,
> Where some, like magistrates, correct at home;
> Others like merchants venture trades abroad,
> Others like soldiers, armed in their stings,
> Make boot upon the summer's velvet buds,
> Which pillage they with merry march bring home
> To the tent royal of their emperor;
> Who, busied in his majesty, surveys
> The singing masons building roofs of gold,
> The civil citizens kneading up the honey,
> The poor mechanic porters crowding in
> Their heavy burdens at his narrow gate,
> The sad-eyed justice with his surly hum,
> Delivering o'er to executors pale
> The lazy yawning drone.

It's a charming speech — the Archbishop, of course, is a major figure of the Establish-

22 Levin, B. (1983) Quoting Shakespeare, in his *Enthusiasms*, London: Jonathan Cape. https://static1.squarespace.com/static/5877ceae5016e102ef4f18f4/t/5b9981b60e2e7257287d6f08/1536786870360/Quoting+Shakespeare.pdf. But see Winick, S. (2020) Proverbs, myths, and "The Bard": Are we really "Quoting Shakespeare"? *Library of Congress Blogs*, 23 April. https://blogs.loc.gov/folklife/2020/04/proverbs-myths-and-the-bard-are-we-really-quoting-shakespeare/ [Ed.]

23 *Henry V* (Act 1 Scene 2).

ment, and we shouldn't be surprised about his very medieval concept of order.

Moreover, he's under pressure from King Henry to find an ecclesiastical excuse for invading France because, if he doesn't, the Church will lose half its property. So the Archbishop has very good reason to be seen as a King's man.

Law and order are paramount, but what about when you have a weak or tyrannous king? This is the dilemma that plagues all of Shakespeare's History plays.

Henry V is a complex, rich, and poetic play, not just a jingoistic spectacle. It was written at a time when England was just beginning to emerge as a global power and was facing off enemies in Spain and France, as well as rebellions in Ireland, Scotland, and Wales. Patriotism ran high. The play celebrates the Earl of Essex's defeat of the Irish rebels, and in one scene, Shakespeare brings together an Irishman, a Scot, a Welshman, and an Englishman in the trenches attacking Harfleur.[24] Naturally, a quarrel breaks out, but all is resolved when the trumpet sounds, and they gather together under the flag of St. George. This is Shakespeare's image of the birth of a united kingdom.

Naturally, the play was popular throughout the 19th century with the expansion of the British Empire. It was so again in periods of intense patriotism during World War I and World War II. In fact, when Laurence Olivier played the role of Henry at London's Old Vic Theatre, he was visited by Winston Churchill, who reminded him, "You are England."[25]

Olivier, who was in the Royal Air Force at the time, was commissioned by the War Office to make a morale-boosting movie, so he chose *Henry V*, which was a great success. But to ensure its popularity, Olivier cut the more contentious scenes, such as Henry discarding or executing his old companions. During the Battle of Agincourt, as described by Shakespeare, Henry ordered all prisoners to be slaughtered in case they mounted a counterattack. Olivier cut that scene too. He just kept the glamorous patriotic bits.

Shakespeare's ambivalence towards war and what Othello describes as "the pride, pomp, and circumstance of glorious war"[26] is well expressed by a young soldier in *Henry V*:[27]

> But if the cause be not good, the King himself hath a heavy reckoning to make, when all those legs and arms and heads, chopped off in a battle, shall join together at the latter day and cry all — 'We died in such a place! — some swearing, some crying for a surgeon, some upon their wives left poor behind them, some upon the debts they owe, some upon their children rawly left.' I am afeared there are few die well that die in a battle, for how can they charitably dispose of anything when blood is their argument? Now, if these men do not die well, it will be a black matter for the King that led them to it.

War certainly has its horrors, and Shakespeare depicts them forensically in his three plays of the history of Henry VI. Civil war is the greatest of evils, and is well-encapsulated in the stage direction: "Enter a father who

24 During August and September, 1415. [Ed.]

25 Or was it Charles Laughton who said this to Olivier? [Ed.]

26 *Othello* (1604) (Act 3 Scene 3).

27 *Henry V* (Act 4 Scene 1).

has killed his son, and a son who has killed his father."

The chaos gives rise to populist demagogues who prey on the ignorance and bigotry of the population to make a pitch for the throne. Such is the rebel leader, Jack Cade:[28]

> We, John Cade, inspired with the spirit of putting down Kings and Princes, command silence!
>
> Valiant I am! I am able to endure much. I fear neither sword nor fire. Be brave then, for your Captain is brave, and vows reformation. When I am King, there shall be no more money; all shall eat and drink at my expense; and, the pissing conduit shall run nothing but red wine for the first three days of my reign. First thing we do, let's kill all the lawyers. How now! Who's there?
>
> A: The clerk of Chatham — he can read and write.
>
> Cade: O, monstrous!
>
> A: We caught him setting boys' homework.
>
> Cade: Here's a villain!
>
> A: He has a book in his pocket with red letters in it.
>
> Cade: Nay then, he's a conjurer! Come hither, sirrah. I must question thee. What is thy name?
>
> A: Emmanuel.
>
> Cade: Dost thou write thy name? Or dost thou sign it with a cross, like an honest, plain-dealing man?
>
> A: Sir, I thank God I have been so well brought up that I can write my name. *Deo gratias*.
>
> Cade: Hang him! He's a traitor! He speaks French! Hang him with pen and ink-horn around his neck. There shall not be a maid to be married, but she shall pay to me her maidenhead ere they have it. Now, away! Some to Westminster, some to the Houses of Parliament, some to the Inns of Court! Burn them all down! Destroy all the records of the realm — my mouth shall be the Parliament of England!

It reminds me of somebody. I can't — can't think who.

So rebellion and civil war are to be avoided, which means that Order must be imposed — until it reaches a tipping point where it becomes tyranny, as we see reflected in *Julius Caesar*, *Richard III* (1592–93), *Coriolanus* (1608). *Macbeth* (1606). At that point rebellion becomes reformation. It's always a delicate balance.

In *Julius Caesar*, Brutus concludes:

> The abuse of greatness is when it disjoins Remorse from power.[29]

It's a sentiment echoed by Isabella in *Measure for Measure* (1604):[30]

> Oh, it is excellent to have a giant's strength!
> But it is tyrannous
> To use it like a giant!
> But man, proud man,
> Dress'd in a little brief authority,
> Plays such fantastic tricks before high

28 *Henry VI Part 2* (1591) (Act 4 Scene 2).

29 By remorse, he doesn't mean "regret" but "pity."

30 *Measure for Measure* (Act 3 Scene 2).

heaven
As make the angels weep.

Shakespeare and justice

We're familiar now with the concept of justice being represented by a woman who is blindfolded, holding in her hand a pair of scales. This image was widely known in Mesopotamia, Egypt, Greece, and Rome. The blindfold indicated impartiality, but what do the evenly balanced scales represent? One hopes they might suggest a balance between justice and mercy. Justice is a cold and cerebral concept, mercy a warm-hearted and compassionate one.

We saw that debate as recently as last December as to whether convicted criminals (all refugees) should be freed or kept in "preventative detention." The debate was largely driven by racism and fear-mongering and became a political football. Could justice be tempered with compassion?

One might do well to hope that here in our own country, the scales might represent justice balanced by mercy and compassion.

This is best depicted by Portia in *The Merchant of Venice*. She accepts that Shylock has the law on his side but urges him to "season" justice with mercy. I like her use of the word "season." It suggests something that adds relish or flavour to something that is cold and bloodless:[31]

The quality of mercy is not strain'd.
It droppeth as the gentle rain from heaven
Upon the place beneath. It is twice blest:
It blesseth him that gives and him that takes.
'Tis mightiest in the mightiest; it becomes
The thronèd monarch better than his crown.
His sceptre gives the force of temporal
power,
The attribute to awe and majesty
Wherein doth sit the dread and fear of kings;
But mercy is above this sceptred sway;
It is enthroned in the heart of kings,
It is an attribute to God himself,
And earthly power doth then show likest
God's
When mercy seasons justice.

Thank you for your very kind attention.

Questions and answers

Susan Pond: My name is Susan Pond, and I have the privilege of being the president of the Royal Society of New South Wales, which has held *Ideas@theHouse*, now the ninth, in partnership with Her Excellency and Government House. John, that was very much what we were hoping to achieve with this series. We've had incredible expositions of great science and, tonight, great literature and great acting. Thank you very much. I will thank you more formally in a few minutes, but we do have time for questions. I would particularly like to take questions from some of the younger members of the audience; we have at least eight university students here. I was thinking about what you might say and therefore what questions to ask. Can you tell us whom you regard as the people who've given great speeches in real life, which have come somewhat close to Shakespeare's figures, and any in Australia?

JB: Well, the people that spring to mind immediately, of course, are Winston Churchill and Abraham Lincoln, who slaved over the Gettysburg Address for hours and hours to make it as perfect as possible. When he made that speech, hardly anybody heard it. He had quite a high, thin voice, and there was a big crowd, and only the people in the front row actually heard the Getty-

31 *The Merchant of Venice* (Act 4 Scene 1)

sburg Address. Thank God it was written down, and we now have it as a great piece of oratory. Churchill, of course, is renowned for his motivational power. Examples in modern politics are a little harder to find.

Q: What about Boris Johnson? Your perspective on Boris?

JB: You know, I've never sat through a Boris Johnson speech, so I don't know how to assess him. I'd like to hear your opinion about who you think a great modern speaker is. I don't think it's been fashionable in recent times to appear too oratorical: don't get too smart, you know, the quip is mightier than the sword. No Australian examples of great orators or motivationals? I'm sure some of you will have answers to that, someone you regard as a great speaker in Australian politics or society. Any offers?

REW: From your comments, I take it that you quite like Paul Keating. What are your observations about him as a leader?

JB: Well, it's interesting because he didn't regard himself as a good speaker, and he was quite embarrassed about it and said, "I don't like doing it. It's all bullshit — making oratorical speeches." I was talking to him at the time and I said, "If you mean it, if you believe it, it's not bullshit. It's just articulating your beliefs and your ideas, so it's not fake, it's not phony." He was much happier doing the one-liners in the Chamber and quick on his feet. He wasn't happy being oratorical, unlike Gough or Bob Menzies, for instance, who revelled in it.

REW: I thought your comments about Mark Antony were interesting, and they seem to draw some parallels to Paul Keating. You said that once Mark Antony had the reins of power, he became disinterested. I'm just interested if you have an opinion on that.

JB: Well, I think the thing about Mark Antony's speech is that it's so devious, it's complete bullshit: being at Caesar's assassination, he was nowhere near it, he was away at the time. But he says, "I was there and I saw this and I saw that," you know, get the crowd all weeping. It's nonsense, showing them Caesar's will, but it isn't Caesar's will, he hasn't got it, it's back home. Brutus sends for it later on, so the whole act is a masterful piece of oratory and stirring the audience up and turning their heads around within the space of five minutes. But it's phony, and that's the kind of thing that Keating was resisting, I think.

LF: John, I draw a distinction between politicians who speak in pursuit of their own interests and statesmen who pursue the interests of their country or community. Is there a similar difference across Shakespeare?

JB: Yes, I think the politician Mark Antony — a supreme politician and totally insincere but convincing — against someone like Thomas Moore, whom I quoted about the refugees: that's a statesmanlike speech. But with others like Henry V, you've got to weigh out "what is this for, what's he got to gain out of making this?" And I think it's highly motivational, but it's to his own ends. So, there aren't that many people, I think, in Shakespeare apart from Portia. Her "mercy" speech, for instance, is totally generous and not self-interested.

Q: Wonderful speech, thank you for that. There are some people these days who accuse Shakespeare of being a misogynist. That seems to me to be quite false because Shakespeare has demonstrated in so many cases his admiration and support for women. Could you comment on that?

JB: Well, I'm sort of guessing a bit here because I never met Shakespeare. I couldn't analyse him face to face. You have to take it all from the plays and see what you can possibly winkle out of that. I would say that when he first started writing, he followed the tradition of women being a bit monstrous, a bit overbearing. So, early plays like *Titus Andronicus*, (1591–92), for instance, with Tamora, the Queen of the Goths, she's a really tough figure. Joan of Arc in the *Henry VI* plays is similar, a very male kind of aggressive figure. But as he goes on, he softens them more and more, and I feel he wants to give women a voice. But it's hard in that society — women don't have a voice — so he puts them into male costume: the girls disguise themselves as men — Viola, Rosalind, Portia — and when they do that, then they have a voice because they're in male attire and they are listened to. So, they can start to rule the roost, and I think he was trying to find a way of liberating women.

Don't forget, he also had an all-male company — there were no women allowed on stage — so the roles were all played by men. So, doing that gender swap was a big challenge for writers, and many of them didn't bother: you'd have all male characters, maybe one female character, because it's just too hard to write and the actors to impersonate women successfully. But Shakespeare must have had some fantastic actors in his company to play parts like Rosalind and Viola and Cordelia — marvellous roles, the best roles for women ever written. So, they were trained to do these female impersonations and to understand how women thought and behaved. They are still unquestionably the roles that most women want to play, so they are convincing.

Interesting with *The Taming of the Shrew* (1590–91), which is often seen as a piece of misogynistic writing, I think it's cleverer than that — it's two people, both of them sort of mavericks, very strong-willed, trying to negotiate how this marriage can work, and that, of course, is the basis of a lot of sitcom and comedy from way back, the male-female battle for superiority. And in *The Taming of the Shrew*, we see concessions being made on both sides, and these two mavericks work out a way of living together. Other people think they're crazy, think they're nut cases, but they do work out their own way: "we can negotiate a way of living together to keep us both happy." And I think that's the message of that play, that you have to negotiate, you have to give a little, take a little, but nobody should feel "I am on top."

JW: My question was going to be about feminism: is Shakespeare a feminist? Can I make a really quick argument that he is and see how you might respond? At that time, women were very largely packages to be passed around for their financial, dynastic, political value, and so they were fairly stereotyped roles. But then in *Richard III*, he has the women who make their curses and their lamentations and who come back as very, very strong women, making their argument about the way women are treated and standing up for themselves in their own rights. There's Lady Macbeth, who's a very, very strong woman, not a nice one, as many of the others aren't, as you've already said, but we get Desdemona and Juliet and Beatrice to whom I think he gives voices that are very strong. These women are equal to anybody else in Shakespeare's plays. They're articulate, they're intelligent, they understand their position in society and the lack of power. But I'll come back

to Portia's beautiful speech. We all learn it in high school, but I think she's actually quite an evil character in the play. She talks about these Christian virtues, and she's not Christian at all. She's one of the most Machiavellian of his characters, and she gets away with it. And everybody thinks she's a heroine because she's so articulate and so intelligent. But she'll deceive you as to who she is. She cross-dresses, she pretends, she's a liar. And when she talks about the quality of mercy, she doesn't even season it when she actually makes her judgment on Shylock — he's destroyed by her, which leads me to Machiavelli (1469–1527). My question is: Machiavelli's and Shakespeare's lives were almost congruent in different languages though, what do you think? Do you believe that he read Machiavelli? Can you talk about the influence of Machiavelli as seen in the plays?

JB: Yes, Shakespeare knew his Machiavelli. In *Henry VI Part 2*, Richard III says, "set the murderous Machiavel to school."[32] A "Machiavel" meant a villain, in common parlance. He was that well known by reputation. If people hadn't read him,[33] they knew all about his philosophy.

As for Portia being evil, I think the play is often misread as a romantic comedy. But I think it's a satire about the law and money and class and race. It's a very tough play, I think, and it's not a romantic comedy at all. She has to save Antonio's life because Antonio is in love with Bassanio and has this hold on him. If she can't break that bond between them, then Bassanio will always be in debt to Antonio, if Antonio sacrifices his life. Her destruction of Shylock — well, you can say she's merciless, but Shylock brings it on himself by insisting on the letter of the law absolutely literally. He's offered so many ways out, but says, "No, I insist on the letter." She says, "Okay, if you want the letter of the law, this is it." That's tough, but it's believable.

It gets one step worse when Antonio adds "And also he must become a Christian," which I think is the worst thing to happen to Shylock — it takes away his culture, his whole identity. That's the cruellest thing they do to him.

I think it's a satire about race. I mean, Portia despises anybody who's not Venetian. She makes wisecracks about the English, the French, the Italians. None of them are good enough. You've got to be a Venetian, a white Venetian — for which you can read Londoner, I suppose. And I think it's very much about hypocrisy, Christian hypocrisy, in the way they treat the Jews.

But nobody's either really good or evil in any of Shakespeare's plays. Yes, she certainly is a trickster, and she gets what she wants, she chooses the man she wants, and marries him, and then saves his friend. An example of that is that her father has decreed that her portrait is in one of three caskets — gold, silver, and lead — and whoever chooses the right casket with her portrait can claim her as his wife. All the other suitors choose gold or silver because that's obviously the only

32 *Henry VI Part 3* (1591), (Act 3 Scene 2). A second occurrence is "Am I a Machiavel?" Host in *Merry Wives of Windsor* (1597–1601), (Act 3 Scene 1). [Ed.]

33 Although *The Prince* was written in 1513, it wasn't published until 1532, after Machiavelli's death. There was no English translation of Machiavelli during Shakespeare's lifetime (translations of the *Discourses* appeared in 1636, and *The Prince* in 1640), but *The Prince* and the *Discourses* were widely read in Italian, French and Latin during the 16th century [Ed.]

worthy vessel for such a divine creature. Bassanio chooses lead, and that's the right one because the father's message is "all that glitters is not gold" and "don't go by outward appearances."

But I don't think Bassanio does it by himself. I think she helps him over the line — she calls for music, and the musician comes on and sings, "Tell me, where is fancy bred, in the heart or in the head? How begot, how nourishéd." So, like say, "dummy, it's in the lead one" and he picks it. And so that's how she chooses her husband and defies her father's will. I think that's a piece of clever trickery, and she always gets her own way. She's admirable in many ways, but as I said also she's tough and she doesn't give any ground.

And I think the other thing about Shakespeare's women is that, as he progresses, they become the moral exemplars. When we get to people like Queen Hermione in *The Winter's Tale* (1611), she's greatly wronged by her husband — he's a jealous, psychotic, crazy man and he condemns her and she apparently dies. In fact, she goes into secrecy for 14 years and in that 14 years, he recovers and gets his mind back and then she forgives him, which is extraordinary after all he's done to her.

But the women become the strong characters, the moral exemplars like Cordelia, for instance, has the moral strength in that play. I don't think Lady Macbeth is all that bad a character. She wants to be. She summons up evil spirits to make her tough, but in fact, she can't go through with it. She can't carry out the murder, and shortly after, she starts to fall to pieces once Macbeth goes rogue. She starts falling apart and finally goes insane and commits suicide. So Macbeth gets tougher and tougher, and she goes more and more desiccated. So she's not as tough as she'd like to be.

So I think the women become the strong moral compasses in the tragic plays and some of the comedies as well. They teach men a lot, and that's in a lot of the comedies, the women teach the men. Rosalind teaches Orlando what love is really all about, for instance. So they become the wise characters, and then they become the compassionate ones and the models of integrity. And that, to the extent, yes, he's a feminist.

Q: Shakespeare's obviously contributed greatly to Western culture and culture in general. The one thing that is of great concern to me is that young people are failing to engage with not just his works but the great works. For most young people, the most experience they have with Shakespeare is Year 10 English, and there's nothing beyond that. And I distinctly remember that the way that we learned about Shakespeare was they had to water it down through *The Lion King*, which is obviously based on *Hamlet*. So how do you get young people to engage and not let his works be forgotten?

JB: That's been a problem for quite a long time. I think when I was at school, there weren't many kids who responded well to Shakespeare. We had a wonderful English teacher and gave us all he could, and only two or three of us really responded to it. Otherwise, it was water off a duck's back. I think that's common with a lot of young people. I think the best way is to see a really good performance that really inspires you, and then you want to know more about it.

Teaching Shakespeare is very hard, especially when you pass the book around the room and everybody reads a line. It kills it like that. The only way is through performance, really, which is why Bell Shakespeare

has an education company playing around the schools and talking to the kids and showing different ways you can perform characters. But that's the only way to bring it to life: get the kids on their feet performing it in a production. That's often exciting for them to feel the thrill of acting it. Not just passing the book around, that's awful. But it's true of most of our great literature, it's more and more fading into the past. Recently, they did *The Importance of Being Earnest* (1895) at the Sydney Theatre Company, and a lot of it was "translated" because they thought Wilde's language is too archaic for a modern audience — Oscar Wilde too archaic! You know, that's when I get worried, when it catches up with us.

JMcL: I'm a social work student from the University of Sydney. I'm in my final year, and I suppose social work is an inherently political profession. We're working with people who are experiencing the most micro experience of the big politics that you discussed with leadership and politics more widely. What sort of advice would you give to social workers going into a field that's flooded with political issues on how to engage in that sort of work with the teachings that you found in Shakespeare? Like what sort of advice could you give to social workers going out into that field?

JB: Well, I think one of the greatest things and necessary things about acting is that you have to listen and empathise and walk in somebody else's shoes. You have to take on that character. You might not like the character, say, like Richard III, but you have to understand where he's coming from, why he's so screwed up. So I think a lot of it is about empathy, and you can find a lot of that in Shakespeare, as in other works, of course. But it's there to be found and discussed: how would you approach this character? What is their problem? What's weighing them down? How do we help that character?

JMcL: That's wonderful, that's actually perfect. Thank you so much.

Vote of thanks

Susan Pond: The applause says it all. You will agree that John Bell has added one more star to the *Ideas@theHouse* firmament.

Through Shakespeare's lens of scepticism and prodigious insights into life, he has shown us that a man from the 1500s is a man for all time, a man for modern times. A man for modern politics.

I believe that Shakespeare would heartily approve of our Society and this series — *Ideas@theHouse* — given his broad sweep across the humanities and sciences. Remember, Shakespeare was alive before the formation of most of today's learned societies.

I believe that Shakespeare would heartily approve of John Bell. John has shown us tonight why he is such an illustrious theatre personality and why he has been a major influence on the development of Australian theatre during his lifetime. He is an award-winning actor, acclaimed director, risk-taking impresario, passionate educator, inspiring leader and memorable speaker.

Please join me in thanking John for treating us to a rare and unforgettable experience.

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Productivity: what it is and why it matters

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This is a discussion about productivity and the related challenges we face in Australia.[1] What exactly is productivity? Well, it's clearly important because it has driven our growth in living standards since the Industrial Revolution. Conceptually it's not very difficult to define. It's simply output per unit of input. But the practicalities are more elusive because what is output? At the firm level or at the level of an organisation you can pretty much define what your output is. But at a national economy level what does it look like?

There's a lot of controversy in economics about the fact that output is increased when you chop down old-growth forests or commit acts of environmental degradation that, according to current measurement conventions, increase the output of the economy. This leads many people to try to devise alternative measures of what productivity should be. But, for better or worse, this is the one we've got: it's GDP, the numerator, with a denominator that is also quite challenging. Originally it was output per person, but with non-standard hours this was changed by governments through the OECD and various measurement bodies to hours worked.

Even if there are defects in the measure, it also provides a comparative benchmark over time. But then the question arises: where does capital fit in, because both capital and labour contribute to productivity growth? It has led to various broader versions of productivity that are also included in the national accounts: multifactor productivity, total factor productivity.

Productivity and wage stagnation

I won't go into a disquisition about the various interpretations of those forms of productivity. The important thing is that we're looking at a trend growth of a particular measure over time and we're going to focus on Australia for that purpose. The worrying thing that we find in Australia — even though business groups and the financial press and everyone bangs on about it every day — is that our productivity growth has been languishing.[2] For some years now, between 2010 and 2020, we have experienced the lowest productivity growth in 60 years, at 1.1% p.a. We were ranked sixth for productivity growth in the OECD in 1970, but we had fallen to number 16 in 2020.

The Productivity Commissioners (Productivity Commission 2023) calculated that if we'd kept going at 2.2% p.a. productivity growth from 1995 to 2023, then we would have a real average annual incomes boost of $25,000 per person. I don't necessarily agree with all of their prescriptions but they can do some pretty good arithmetic at times. The boost would even be more — maybe $3,000 to $5,000 more — had it not been for

1 This is an edited transcript of a talk given on 7 Feb 2024: https://www.youtube.com/watch?v=kgKjzlphgeo [Ed.]

2 "Australia's real long-term problem is its fading productivity," *AFR*, Jan 21, 2024.

the fact that in recent years workers have had a lower share of the productivity gains than has capital. That's another story in itself, which is generally described as "wage decoupling."

What this has meant is that we are now experiencing something everyone is painfully aware of: a cost of living crisis (Figure 1). It won't be solved by changing tax policy because it's a much deeper problem. It relates to the underlying structure of the economy.

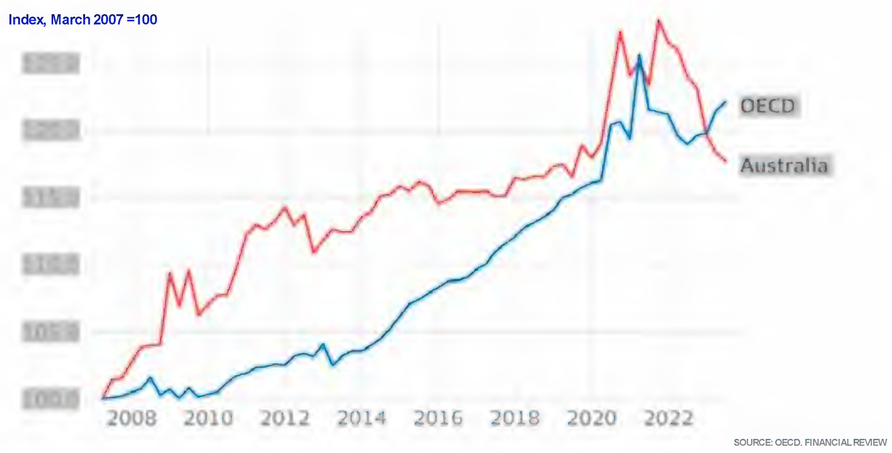

Figure 1: Real gross household income per capita, AU v OECD

What connection can we draw between productivity growth and the growth of national income — in this case, real income growth per head? Figure 2 is a very useful graph. It's a Treasury graph that was provided for the Intergenerational Report; it describes the history of what's been happening over the last 30 years or so.

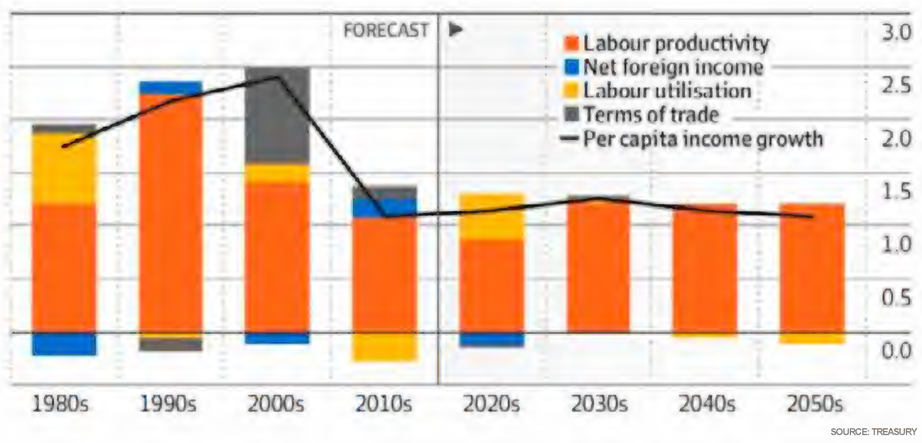

Figure 2: Components of real income growth per capita

On the left-hand side (in the 1990s) is a big red blotch which is the growth of labour productivity. Labour productivity was growing quite fast then: it was the period of the Hawke/Keating government's economic reforms. What people don't recognise about those reforms is that they weren't just about freeing up the capital and labour markets: they were also about the development of a very coherent industrial policy to transition industry from large-scale mass-production industries to smaller-scale, more specialised SMEs that could find a place in global markets and value chains.

A complete restructuring of the Australian economy was going on at that time. People forget that in the late 1990s, the fastest growing area of world trade for us was elaborately transformed manufactures. Even though a lot of our traditional manufacturing industry had been hit by the earlier removal of tariffs, nevertheless new, more specialised, knowledge-based industries were growing at that time, because there was a commitment to R&D and to innovation.

Commodity boom

Things changed in the 2000s. For many people living in this country the change was quite beneficial because we experienced a massive commodity boom, an unprecedented commodity boom, the biggest most likely we'll ever have in our lifetimes, increasing our standard of living by 15% over a six-year period without us having to do a thing. We were getting higher prices for our raw materials, especially iron ore and coal, which we might call the gift from China.

It boosted our terms of trade and hence boosted the dollar, but the impact was to make uncompetitive a lot of those new, growing, interesting, specialised firms in manufacturing. We lost about 100,000 man-

ufacturing jobs over an 18-month period. It was a genuine crisis for manufacturing industry, but no one noticed because everyone was experiencing an increase in their income per head, and life went on without addressing the underlying issues.

Other countries have faced that problem as well, other resources-based economies. The most obvious one in the post-war period was Holland — hence the term the "Dutch disease" — because they discovered North Sea gas and the price of the guilder went up and much of their manufacturing went to the wall. It took them about 10 years to restructure their economy to accommodate to the new situation.[3]

During the 1970s and '80s, the UK also experienced this phenomenon after the discovery of North Sea oil and gas, which drove up the price of sterling. A lot of manufacturing went to the wall; after a period of a consumption boom there was nothing to show for it at the end. It was part of Mrs Thatcher's economic experiment: she wasn't interested in reconstructing the economy, she was simply interested in ensuring that financial interests got a greater foothold over the national operation of the British economy. And that's exactly what happened, with everyone facing crumbling infrastructure — schools, universities, hospitals — at the end of the 1980s. People at the time suggested that this is a price that the British will pay for decades, and of course they are.

Did we learn from this experience in the commodity boom that we enjoyed in the 2000s? Sadly not. Others did, but not us. We had a consumption boom as well and we've ended up with lower living standards now because the terms of trade boost is gone, which at the time masked a structural deterioration in our productivity performance.

Norway is the counter example, again with access to North Sea oil and gas. They took a public stake in their major oil company, Statoil. They introduced a resource rent tax — you might recall Kevin Rudd trying to do the same here — but their resource rent tax wasn't the 20 or 30 or 40% that was being proposed in Australia; instead, theirs was a 76% resource rent tax. They used that to create what has now become the world's largest sovereign wealth fund, which invests around the world and in the future of their economy, for future Norwegian generations, building up their research and education infrastructure for many, many decades to come.[4]

That was clever. We missed the chance to do that and so what we have is a hollowed-out economy, as we'll see below, especially with the decline of our manufacturing sector.

Explanations of stalled productivity growth

The decline of productivity growth isn't just a phenomenon confined to Australia: we see something like it happening across the world. It's just happening more acutely in this country. It is also occurring in the US and Europe, and there are various interpretations that have been applied to why this might be the case. One is that the last couple of decades are in fact not so transformative by comparison with what we saw occurring in the late 19th century and early 20th century, with indoor plumbing, electricity, the tel-

3 The Australian equivalent in the 1970s was the Gregory Thesis. See Gregory 1976. [Ed.]

4 https://www.nbim.no/en/ [Ed.]

ephone, commercial flight and many other developments that we now take for granted but which were genuinely life-changing at the time. These developments provided a huge boost to productivity, and hence living standards, for those populations.

What Gordon (2000) and various economists in the US would now say is, "The internet — what's it ever done for us?" by comparison with all of these major innovations that changed our lives in the past. He's a bit of an outlier but there's a certain amount of common sense in the argument.[5]

Another interpretation is that productivity is just too hard to measure — it's ongoing but we can't measure it because so much of what is now produced is intangible, especially with the growth of digital and AI. How do you measure it, for example, if a lawyer uses AI for a brief? Does that appear in the national productivity statistics? That's going to be a big challenge.

But the most widely accepted interpretation among economists — especially Erik Brynjolfsson and Andrew McAfee at MIT and various scholars in the UK and in the OECD — is that, yes, we do have productivity growth but it's at the technology frontier, in relatively small cohorts of firms in each country. Productivity growth on average is defined by the size and success of that cohort. The problem is that the productivity growth and the technological change that they're experiencing haven't been diffused or deployed through the economy — that is yet to come — so we must wait for the impact. In the meantime it's this cohort of firms — all the big tech firms, the really sharp manufacturers that have captured world markets in the US, China, Europe — these are the firms that are driving productivity.

In this interpretation, the issue of how much productivity growth we get on average is determined by the proportion of these firms in the economy. The proportion of such firms in the Australian economy is very small. We have a much larger group of the firms that the OECD would describe as "laggards," and very little in the way of institutional structures to deploy the productivity growth and the technology expertise at the frontier to the rest of the firm population.

The AlphaBeta consulting firm did some interesting work for the Federal government a couple of years ago, when it analysed the R&D intensity of different sectors. It was less the R&D intensity within the sectors than the composition and presence of those sectors in the economy that made the difference. If you have a larger manufacturing sector, and the manufacturing sector is the biggest driver of productivity in the economy, then you have greater productivity growth in your national statistics. If your manufacturing is hollowed out — well, that's us — then you're highly likely to have a lower rate of productivity growth.

Technological change and innovation

What drives productivity growth in these high-skill, high-value-adding firms? (Figure 3). Essentially, it's technological change and innovation, but it's not always technological innovation: there can be non-R&D forms of innovation as well — new business models, systems integration, new work and management practices — but, generally speaking, technology is what drives it.

5 See https://en.wikipedia.org/wiki/Productivity_paradox [Ed.]

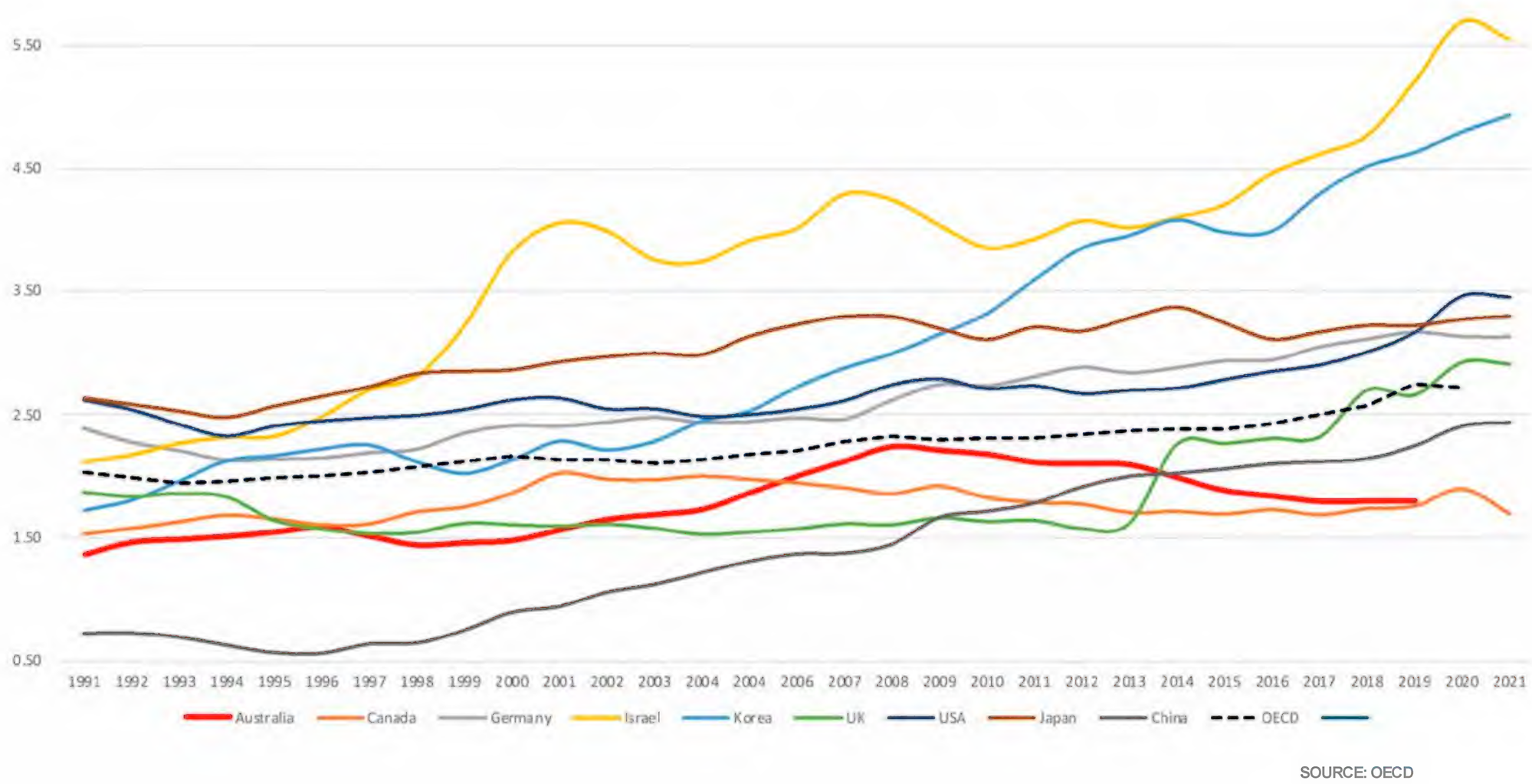

Figure 3: Gross Expenditure on R&D as % of GDP 2003–2020

Technology hasn't been recognised in the traditional neoclassical production function models in the past, but new theories around so-called endogenous growth have made technology the centrepiece of productivity and industrial transformation in modern advanced economies. What we find in Australia is that R&D for this country has been languishing, along with Canada's — Australia's is the red line going down the bottom in Figure 3. Others — Israel, Korea, Japan — have been experiencing massive productivity growth, and that is entirely through their commitment and investment in R&D. In Australia, R&D has been going backwards for some years — we were at about 2.2–2.3% p.a. a few years ago, but we're now scraping along the bottom at 1.68%.

The government has a target to get to 3% of GDP, but at 1.68% the question is what's the road map for getting there? In particular, our business expenditure on R&D has fallen behind almost every other country. For Australia, BERD (business expenditure on R&D) is about 50% of R&D generally. In the US it's 70%. This is partly because we have a very fragmented research and innovation system, if we can call it a system.

My colleagues and I did a study a few years ago for the government showing that we had research and innovation spending spread across 13 different portfolios of government, 150 different budget line items, very few having connected with each other. We have also, by the way, 60 official review reports since the Keating/Hawke period, on how to improve our R&D system, none of which has had any implementation strategy attached to it.

How do we get to this 3% target? In one sense it's quite easy because ATSE has done a calculation, together with Universities Australia, in which they find that $1 of R&D creates or adds $3.50 to the economy overall.[6] So if we spent $4.4 billion per annum up to 2035, we would reach the 3%

6 https://www.csiro.au/en/news/all/articles/2021/november/value-innovation-investment [Ed.]

target, and it would also add $133 billion per year to our economy. Why don't we do that? $4.4 billion a year is not all that much: you might want to compare that with how much we spend, for example, on the diesel fuel tax rebate — $7.9 billion a year for a handful of international mining companies to drive diesel trucks across their mining sites. Wouldn't it be smart to start allocating those resources to R&D instead, and to contribute to the future of this economy?

Narrow trade and industrial structure

But the problem is even deeper, unfortunately, than simply R&D. It goes to our narrow trade and industrial structure. There is a very interesting exercise that some of you may be familiar with — the Harvard Atlas of Economic Complexity.[7] It's an annual report that's done to show the economic complexity or otherwise of 130 or so economies around the world. Economic complexity measures the diversity and research intensity of the export mix. I'll give you a couple of examples.

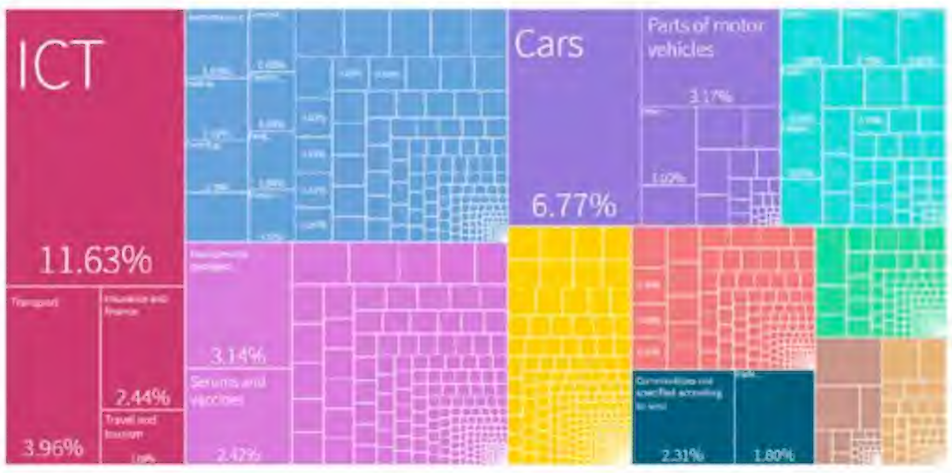

Figure 4: Economic complexity — Germany #4

Germany is number four and the area which predominates in the German export mix is around Machinery, the next area around Medtech and Pharma, and cars and car parts, ICT — this is a highly complex economy and it is very largely driven by advanced manufacturing (Figure 4). Canada (Figure 5) (#41) is a bit more comparable with us — another resources economy — also languishing in this ranking, and there is a predominance of raw-material exports, but also a fair sprinkling of complex activities and value-adding within manufacturing, particularly in the automotive industry.

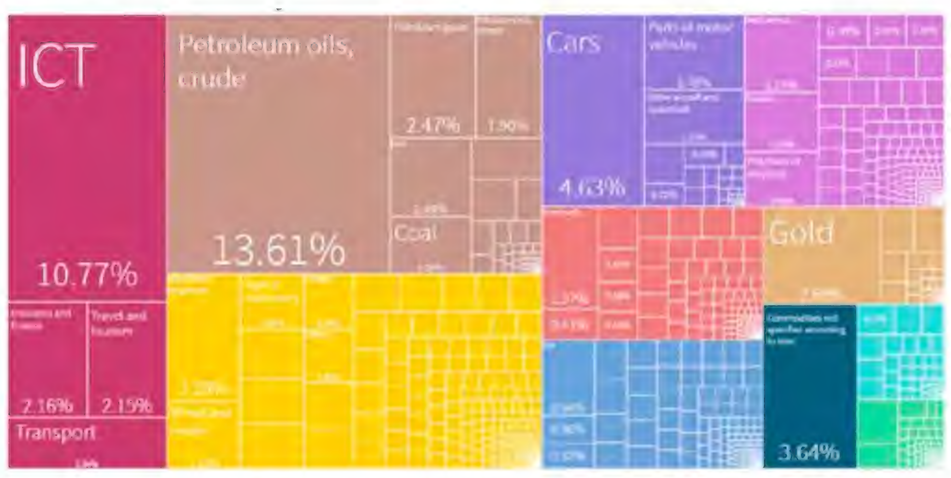

Figure 5: Economic complexity — Canada #41

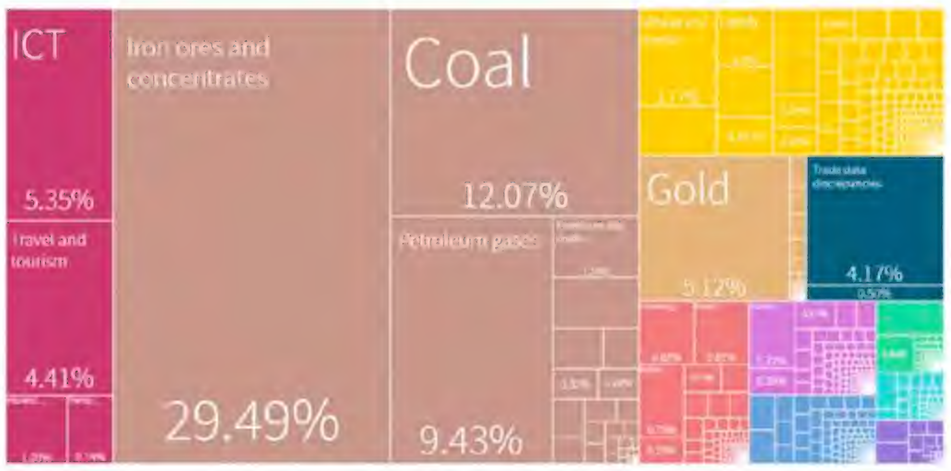

Figure 6: Economic complexity — Australia #93

When we look at ourselves (Figure 6), we're now #93 — in the 1990s we used to be around #50 — and unprocessed raw materials dominates our export mix. The Productivity Commission thinks this is absolutely fine because we have a comparative advantage in unprocessed raw materials. But we only have to imagine what might happen if the raw materials component of exports disappeared overnight — for example, if the Chinese decided not to buy our iron ore — we would have a big gap in our export mix to fill. Coal volumes are

7 https://econlife.com/2020/01/a-simple-look-at-the-worlds-most-complex-economies/

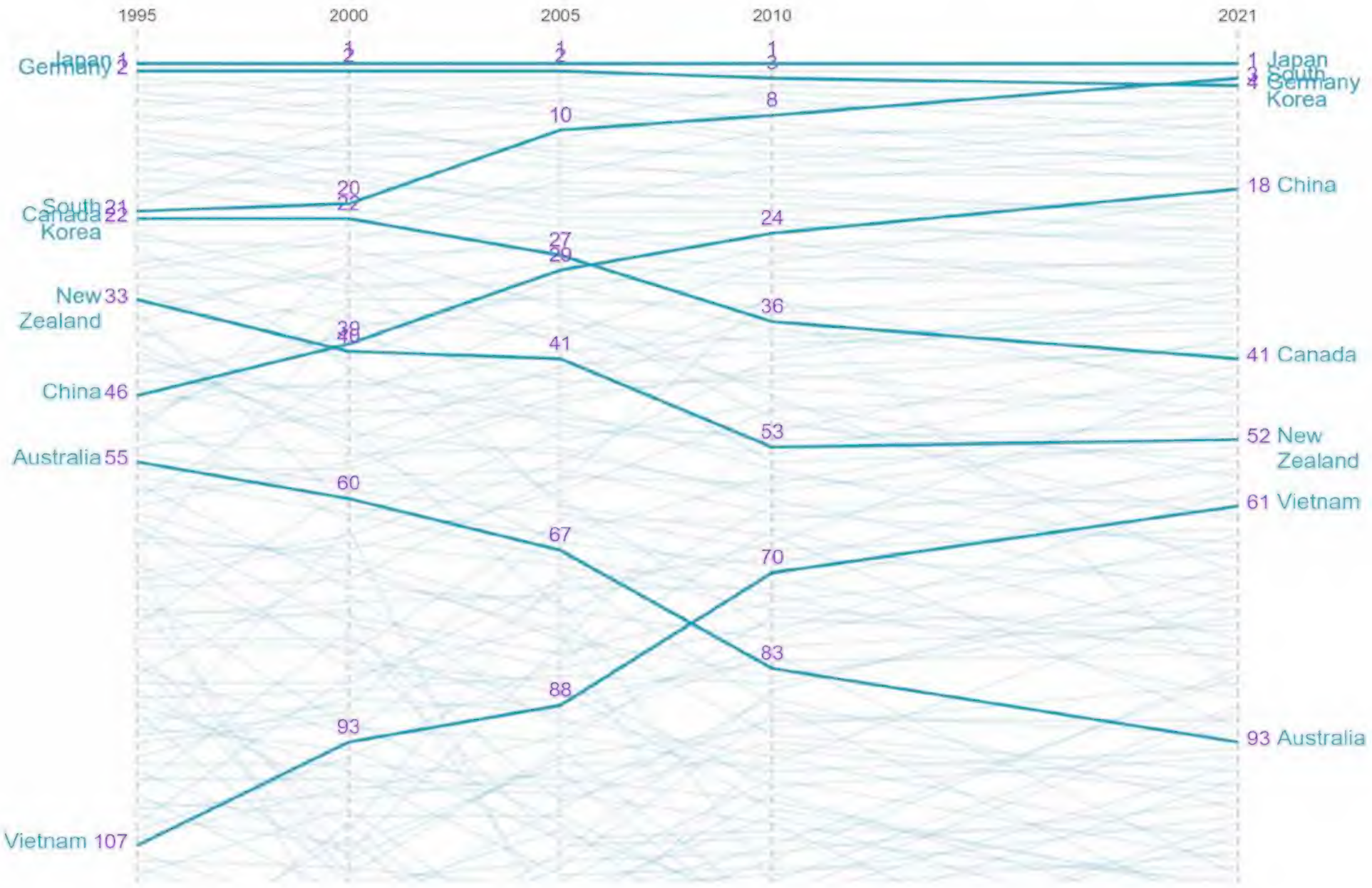

Figure 7: Complexity comparison

already in decline. Those export values are what enables us to import all the complex stuff that we don't manufacture or build here ourselves.

There is an indication of the degree to which we've slid down these rankings — Australia, also Canada to some degree, but what's happening to the rest of the world economy, or at least the examples I've selected? (Figure 7). The East Asian countries have really begun to dominate these rankings and even Vietnam has managed to pull itself up into, if not a first-world country, then well on the way to being a technological powerhouse.

The issue around our narrow trade and industrial structure is exemplified in a vaguely amusing way by this *Economist* (2023) article recently, which asked the question: what if Australia and Canada were one country and we called it Ozanada? It would be an economy almost as big as Germany's but based almost entirely on the export of raw materials. Lagging far behind other comparable countries in terms of its high-tech exports, representing 7% of the combined exports of OECD countries, but only 4% for Canada and less than 2% for Australia. The article concludes that this is "not for want of well-nourished brains" — Ozanada is "home to world-class universities and boasts some of the highest rates of tertiary education". Rather, the problem is an "underfed innovation system."

It's not as though we didn't know this, and we've known it for a very long time. I'm reminded always of the Science and Technology Budget Statement in 1993 issued by Treasury, which said, "Our most urgent task is to build an innovative culture in industry. Above all, we need a cultural change among business leaders, decision makers and the community generally, which recognises the major significance that innovation has for

building national competitiveness. A clear sense of direction, planning, leadership are needed to achieve our goals." Well, we have a long way to go and it isn't just a question of market failure. It's a massive systems failure across our economy and in our institutional structures.

This failure is also reflected in another measure — location quotients — that was devised by an American think-tank, the Information Technology and Innovation Foundation (ITIF), which looked at the presence of advanced industries in each country.[8] If we say the average is 1.0, then in 1995 we were 0.56, so quite well behind the average. In 2018 it fell to 0.41 and now we've dropped almost to the bottom of the 74-country ranking. By "advanced industries" here we mean Medtech, Pharma, Electronics and IT machinery. This has also meant that we've dropped down every other ranking — for example the IMD competitiveness ranking and the Global Innovation Index, which we come to below.

Ranking	Country	
1		Switzerland
2		Sweden
3		United States of America
4		United Kingdom
5		Singapore
6		Finland
7		Netherlands
8		Germany
9		Denmark
10		Republic of Korea
24		Australia

SOURCE: GLOBAL INNOVATION INDEX, WIPO,2023

Figure 8: Global Innovation Index Ranking

Innovation inputs and outputs

A recent finding by the Australian government itself was that, of our companies, 98% do not produce new-to-the-world innovation; only 2% do. Let's unpack that by looking at the latest Global Innovation Index rankings[9] (Figure 8). At the top of these rankings are the usual impressive suspects, and we're at number 24, so you might not think that's too bad. But when we drill down, we can see where and what the issues are (Figure 9). We're pretty good at innovation inputs, but it's the innovation outputs that are the major problem. Innovation inputs, tertiary enrolments — we're right up there, also females with degrees, our university rankings, scientific articles which essentially drive the rankings, and our use of ICT.

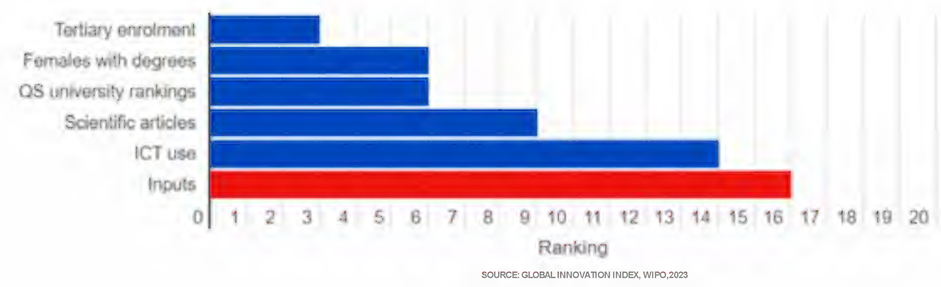
Tertiary enrolment
Females with degrees
QS university rankings
Scientific articles
ICT use
Inputs
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Ranking
SOURCE: GLOBAL INNOVATION INDEX, WIPO,2023

Figure 9: What Australia is good at

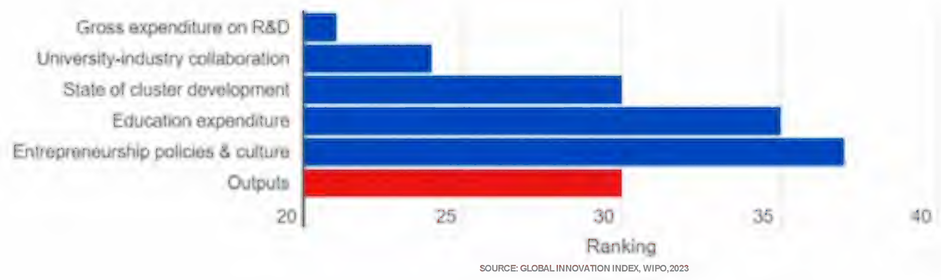

Figure 10: What Australia is not so good at

What we're not so good at (as we see in Figure 10):

- the translation of university R&D into commercial value through university/industry collaboration
- cluster development: the development of areas of specialisation that can achieve

8 https://itif.org/publications/2023/12/13/2023-hamilton-index/ [Ed.]

9 https://www.wipo.int/pressroom/en/articles/2023/article_0011.html [Ed.]

critical mass in global markets and value chains

- our education expenditure: we think we spend quite a lot on our education expenditure, but we don't, compared with other countries — if we took that number and made it public expenditure per pupil, we'd go out to about number 60
- entrepreneurship policies and culture: we're improving but we're still not up there with the entrepreneurial leaders.

Our outputs of innovation — what we do with the inputs — lag far behind all the other OECD countries. Let's return to R&D and disaggregate our expenditure on that (Figure 11). This is a growth index; the orange and yellow bars are the growth of government and business expenditure on R&D in Australia. It's not going anywhere; in fact, it's going down. What's going up is higher-education R&D: it's universities in fact that are doing the heavy lifting now for Australia's R&D effort.

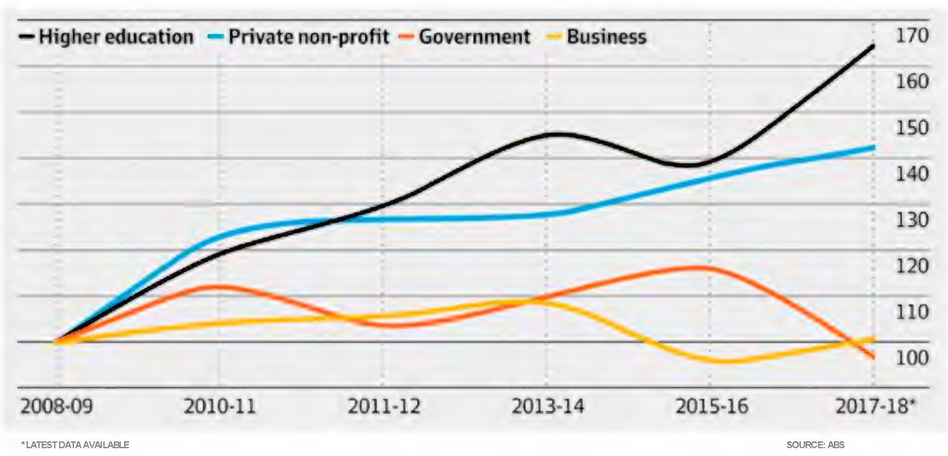

Figure 11: Gross expenditure on R&D, Australia growth index

This is good in a sense but not for the best of reasons. It is only occurring because we're attracting large numbers of international students whose fees are then diverted to filling the gap that would otherwise be filled in other countries by public expenditure on research and innovation. By diverting these student revenues to research, we increase our rankings and attract more international students, and we continue on what one of my colleagues has depicted as a very precarious hamster wheel. It's not necessarily producing the research that we need as a country: a lot of it is medical research, which is fine, but the sort of research that's needed in industry is science and engineering, or business and organisational design, and that's the research that we're not necessarily funding.

More than that, world research is no longer necessarily breakthrough research that can change the game in industry and society. There was a very interesting piece of work published in *Nature* on research productivity recently (Park et al. 2023), which noted that more research is being done than ever before but asked the question, Why are we getting less and less breakthrough research? Is research becoming too incremental? The authors looked at 45 million published articles across the world, using an AI tool with various keywords, to determine which were the breakthrough research pieces, as affirmed by citations, that would transform the way we work and live, and certainly the way future authors would understand an area of interest.

They found that over a long period of time since the Second World War, we've seen a significant decline in breakthrough research as it becomes more incremental. Why is that occurring? Because research itself is becoming narrower and narrower in each of our disciplines and subdisciplines, hence we're missing the sparks of creativity that occur at the intersections of disciplines. It's another angle on productivity — something that's not just peculiar to Australia but is a global phenomenon.

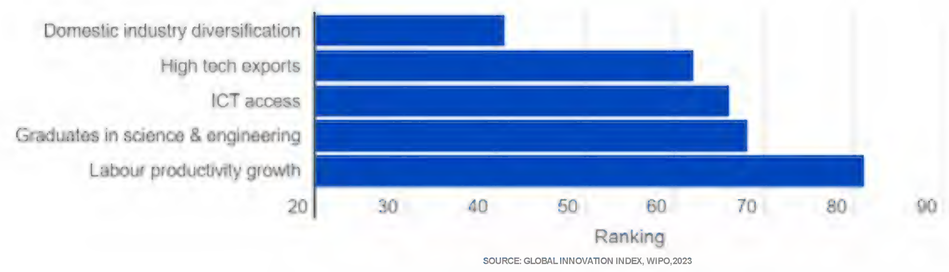

Figure 12: Where Australia lags most

The bad news for Australia becomes even worse (Figure 12). Let's look at our domestic industry diversification. We looked at the export diversification with the Harvard Complexity Index: this is our domestic diversification, lagging at 40 out of the various countries surveyed. High-tech exports which are part of that ICT access, essentially reflecting the botched National Broadband introduction. Graduates in science and engineering lagging — we are short of 50,000 engineers in Australia. Where are they going to come from? We only produce 13,000 a year. All culminating in the poor performance as reflected in our labour productivity growth.

Government priorities

What we can do about productivity and wage stagnation? It's always possible to undertake policies that are transformational in this country, should governments at every level decide to do so. Why is it so hard to make these decisions? The Federal government would argue that it has sorted out its priorities, primarily in the context of the new National Reconstruction Fund. These are: Renewable technologies; Transport; Value adding in agriculture; Value adding in resources; Defence capability and aerospace; and Enabling capabilities around new technologies. All of these are good so far as they go, but the NRF is not an industrial policy, just a financing mechanism.

The key questions must be: what are the problems we are trying to solve; can we build national missions around them; and what does the implementation strategy look like? The new NSW Industry minister has identified some areas where missions can be devised. He advocates that we support firms developing the industries and technologies of the future; he has identified various sectors that we can focus on. We're very good at listing these things, but where is the implementation strategy? The minister hosted an innovation blueprint summit in February 2024, so we might find out more about his thinking and how he would like us to contribute.

Figure 13: Global energy investment in clean energy and in fossils, 2015–2023e

Finally, let's ask ourselves: since we've missed so many opportunities up till now, where can we play as a country? Ross Garnaut (2019) has made the compelling argument for Australia to be a renewable energy superpower. We're fortunate to have been given another chance as a country, after falling down on the job during the commodity boom. Global energy investment is the fastest-growing sector in the world for productivity growth (Figure 13). It will be a $1 trillion sector by 2050. Already the investments are way out-stripping fossil fuels. It's a tremendous way to increase productivity and restore our manufacturing capability, because we can now use the immense resources of wind and solar to produce the electrons — which we can apply either directly or through hydrogen and its

various forms — to create new industries and transform existing ones, with green iron and green steel, green aluminium and green copper. Europe is about to introduce a border adjustment mechanism[10] which will penalise supply chains that are not low-carbon. We can do low-carbon manufacturing activities here and become a manufacturing exporter at scale, if we get all of these things right, in a framework that does it coherently, which we currently don't have.

Policy architecture

What I think is essentially missing is a coherent, coordinated innovation system, which is in fact what you find in most other countries that do enjoy a high level of productivity growth and related presence of advanced research-intensive industries.

Five components in a policy architecture

Mission-led industrial policy

What are the problems we're trying to solve? How do we turn these into national missions for the country and put our resources behind those missions? It starts with technology foresighting: where are the areas of current and future competitive advantage, as opposed to simply comparative advantage? Comparative advantage is about our natural endowments; competitive advantage is about our knowledge and ingenuity. How do we identify these, rather than just list priorities? What are the issues and problems we need to address, and importantly how do we build a coordinating focus in government to take missions forward? Examples elsewhere include: Sweden's Vinnova; InnovateUK; the Netherlands' top sectors etc.

Research and technology development

Let's not miss the opportunity to put additional public resources into research and technology development, including basic research, because basic research has declined as a proportion of our research spending. While some might say we shouldn't do research for its own sake, the fact is that if we don't have basic research, we won't have anything to commercialise. That connects then with the applied research that we do in CRCs, in CSIRO, in universities, which can then be mobilised around the missions.

Place-based innovation ecosystems

These are an increasingly important part of the process of translating ideas into commercial and social value and diffusing them across SME networks. This is an approach that is taking place around the world, not only to promote research and innovation, but also to transform existing industries and create new ones.

The Fraunhofer Institutes are probably the best longstanding example, in Germany.[11] The British picked this up, albeit less well-funded, with their Catapult Centre network, especially the High-Value Manufacturing Catapults.[12] The US is now doubling down on this approach in the Biden CHIPS and Science Act of 2022,[13] with National Science Foundation Regional

10 https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en [Ed.]

11 https://www.fraunhofer.de/en/about-fraunhofer.html [Ed.]

12 https://catapult.org.uk [Ed.]

13 https://new.nsf.gov/chips [Ed.]

Innovation Engines[14] and something called the Microelectronics Commons[15] which are technology hubs around the US. An immense amount of money is being spent on each one — $200 million per ecosystem or hub. They are characterised by their ability to bring together universities, research institutions, industry — especially large anchor companies — and government funding in a collaborative way, to not just do a linear pipeline from an idea to a commercial outcome — which is the traditional way of understanding commercialisation — but through the interaction of multiple disciplines, individuals and institutions to devise programs and industrial applications that no one might have thought of before those interactions took place.

A good example with the Catapults is Formula 1 technology: they thought, "You know, our car industry is gone now so we'll at least work on Formula 1 cars which we're pretty good at". Out of new precision pit-stop engineering, they designed new ways of managing operating theatres in hospitals which then became a new export industry for Britain. These are the sorts of things that happen at the intersection of disciplines.

Public sector as innovation driver

The US does this very well with the SBIR (Small Business Innovation Research program),[16] where each government department is compelled — it's not voluntary — to set aside a certain percentage of their funds to enable local SME technology development to solve the problems and meet the needs of those public-sector institutions, especially in the health system. It's the most important innovation program in the US, along with DARPA and a few others, and it has certainly been transformative for SMEs and micro firms, enabling them to scale with leading-edge technologies and business models.

We could do that here: nothing to stop us from making sure that, if we do procurement in certain areas, we don't do this crazy Treasury "value for money" thing, which means that we buy Chinese or Korean trains that don't fit on the tracks or ferries that don't fit under bridges, ultimately costing much more and destroying local capability in the process. Why wouldn't we do procurement in such a way that we build potentially scalable home-grown companies and workforces? This would be value for money!

Skills and capability building

Finally, that brings us to skills development, which is often neglected — especially when contracted out to private operators — but is essential here.

For example, we could go into offshore wind. The Port of Newcastle is supporting the development of an offshore wind facility which will supply 3–4 gigawatts of energy. This will feed onshore hydrogen electrolyser infrastructure for the production of ammonia and possibly green iron and green steel, facilitating the region's energy transition and economic diversification. The company that's currently the front runner for allocation of the tender has set out — it's a Norwegian company, of course — its vision of what this would look like. Part of its

14 https://new.nsf.gov/funding/initiatives/regional-innovation-engines/about-nsf-engines [Ed.]

15 https://microelectronicscommons.org [Ed.]

16 https://www.sbir.gov [Ed.]

vision is they would build the platforms here, onshore, but they've said to us, "By the way, if we're going to do that, we need 4,000 welders on day one." Where are they going to come from?

Conclusion

To finish, these are the challenges that we face; all of them are solvable, I think. But we need a vision of what the system can look like: a system that draws on the best examples from around the world, then designs and implements it in a way that works for this country.

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Questions & Answers

Q: There's a wonderful example of the place-based innovation ecosystems from the '50s which was summarised in a really good book called *The Ideas Factory*, which described the success of Bell Labs, where they invested a huge amount of money and hired scientists and told them just to go for it, not measuring what they did.[17] Not giving any instructions. There was an economic analysis of this and the value added was just fantastic, so it does work but you know there's got to be some innovation and drive to do it.

A: Yes, that's a really interesting area. Those large labs — Bell Labs, IBM — they were the drivers of a lot of innovation, more so at the time than from universities, and the question people ask is why did those labs disappear, why did they decline and disappear? Because those companies — this is really interesting — began to outsource their R&D in tandem with the weakening of US antitrust legislation. While antitrust provisions were in force, those companies couldn't just buy other companies and take their ideas (which is what's happening now), they had to develop everything within their

17 Jon Gertner (2013) *The Idea Factory: Bell Labs and the Great Age of American Innovation*, Penguin.

own organisation, hence building their own labs. Now, if you're a very large company in the US — and the big tech companies are the obvious example of this — if you see an innovation going on in a start-up or even something a bit larger — like Facebook taking over WhatsApp — you just buy it. Obviously, Facebook and Google and so on are doing a lot of R&D themselves as well, but it certainly ensures that they can consolidate their position without doing everything themselves or being in competition with anyone.

Q: Thank you for your wonderful talk. I wonder if I could ask two questions: one, could you comment on the impact on all of this by the corporatisation of universities and, as an aside to that, would you comment on the fact that the next Vice Chancellor of ANU is Genevieve Bell. The second question is: does the different social environment of Scandinavian countries have an impact on all the kind of stuff you've been talking about, having in mind that generally in global economic statistics Scandinavian countries are well in advance of Australia?

A: I'll answer the second one first; it's lot easier than the first. Absolutely, so the Scandinavian countries have not only an innovation system but they also have a social system which supports it. So if you want to take the risk of undertaking start-up activity and you fail, you have a social safety net, and that gives people a great deal of security about pursuing R&D activities or entrepreneurial activities that you might not have in a more deregulated economy.

They also put a huge amount of their own public resources (because they pay more tax) into R&D and so you know if you're paying high rates of tax, you can devote substantial public expenditure to both social and economic ends. Hence those countries have the highest productivity growth, contrary to the impression given by neoliberal think-tanks who don't like to mention the Nordics, as well as having the highest rating on the World Happiness Index.

As for universities, I'm not quite sure where they fit on the Happiness Index these days, but yes there's a certain amount of corporatisation that's occurred since the Dawkins reforms. I remember in my university at the time we were looking at this in the early 1990s and asking ourselves what did it all mean. What it seemed to mean was that the vice-chancellor was effectively no longer an advocate for us in government, but instead an advocate of the government in our university. Clearly vice-chancellors have pushed back since then, and I'm sure Genevieve will be one of those, but universities have nevertheless become more corporate institutions. There's still a lot of scope for academics to do the things that they're good at, despite having to rely increasingly on the international student revenues I mentioned earlier, but I can't imagine anyone has not noticed the huge rise in bureaucracy and form-filling that makes life more challenging these days. Fortunately, I don't have to do much of that anymore.

Q: Roy, thanks very much for your very interesting talk. One of the underlying themes in your talk was the fact that manufacturing industry is much more innovative than the services sector, though the way that exports of raw materials have boosted the exchange rate has had a damaging impact on the manufacturing sector. I don't see how we can change that system because at the moment we still think it's very important to export rocks. I think the whole policy we still follow seems to be that we must export

more of our minerals and that's going to help our society in the future. How are we going to change that?

A: Well, that's the $64 billion question. The Productivity Commission would say we don't need to change it because we're good at exporting rocks. And what a thrill it was when we found that batteries were made of lithium because it meant that we could continue exporting raw materials, and now lithium will take over from iron ore and be the next big commodity boom. Well, that didn't go so well: lithium is already oversupplied now in the world economy and its price has dropped dramatically. But even if it hadn't, wouldn't it be smart for us to move into the whole value chain of battery production, energy storage, personal mobility, as Canada is in fact trying to do itself?

Right now when it comes to lithium, we produce 50% of the world's lithium and export 90%, most of it to China. We capture 0.53% of its final value, and so when the AUKUS arrangements suggest to us how wonderful it will be to be incorporated into the U.S. Defense Production Act, the question we should be asking is not how much raw lithium can we sell to the U.S., but do we have the opportunity in that arrangement to move up the value chain? At this stage, the jury is out.

Q: You mentioned the importance of generating research that upon implementation maximises the productivity of all other sectors of the economy. Could research productivity be improved through adopting a collaborative approach across all portfolios during the translation of research?

A: Do you mean across government portfolios?

Q: Not just government portfolios but also across various faculties within universities as well?

A: Yes, absolutely. Well, certainly at the government level with limited resources, it doesn't make any sense for us to have a defence research strategy, an energy research strategy, a health research strategy, and something around the departments of industry and education. There should be a single strategy around industrial transformation, and social well-being, and all of these elements can feed in, because there's so many potential crossover points and points of intersection between the disciplines.

But that sort of siloed thinking mirrors exactly how we operate our universities, because, with the focus on top-tier peer-reviewed publications (which are increasingly narrow), everybody's incentive is to publish in those journals, not to work with someone in a different discipline. Except, you know, there's a few odd-balls around who might like to do that, but it won't stand you in good stead if you're a young aspiring researcher in a university. It won't give you the sort of promotion opportunities you would have if you doubled down on the narrowest possible subdiscipline area and published in the top journal in that area, that might not ever have any further application, or even have a very wide readership. I think universities need to push against the ranking exercise that forces them to do this.

How many German universities are there in the rankings? Not all that many: they've made a conscious decision that it's more important to connect research to the future of their economies and societies rather than simply chase rankings for their own sake, and the same goes, I've

noticed, in business schools in Germany, with their complete disregard for MBAs. They have very interdisciplinary Masters of Management programs that bring together engineers, designers, all social scientists, all sorts of interesting people. That plays into the whole Fraunhofer system as well. So there are different ways of doing this — we just don't do it.

Q: Thank you very much, Roy. You're absolutely right about the inputs: the most recent index of creativity showed that Australia is the most creative country in the world, but we rate very poorly on innovation, exactly as you say, and we obviously need a mission-led industrial strategy, so thanks for promoting it. We see all the problems but in terms of an opportunity I'm wondering what you think about opportunities from AUKUS, given that the US and the UK will be sharing IP with us.

A: If the submarines appear by 2050, I'll be very surprised, and money we spend on refurbishing American shipyards is money we won't be spending on our own R&D. So I guess I'm not very favourable to that way of thinking. Maybe there will be some opportunities, but I think they've been overblown because politicians like to give the impression that it's going to be nirvana for Australian industry. But, as I said before, it will be for very specific areas of Australian industry. There might be some small defence companies or space companies that get picked off by American primes — we might lose them; we are losing them as we speak. I would put a lot more emphasis on sovereign capability even though it's the rhetoric of governments now, but we don't actually do it and I'd be very concerned if we lose a lot of the important research collaboration opportunities that we have with other countries because we're putting all our eggs in that basket.

Q: Roy, a lot of this is déjà vu: we've been hearing about the issues in the Australian innovation system for a long time and you've got mission-led industrial policy up the top. The problem is that it changes every three years. So how do we overcome the lack of continuity in our thinking; how do other countries overcome that?

A: Well, you have continuity if you insist on it and other countries do: if the government changes in the Netherlands (which it's currently doing) or in Finland or Ireland or other places like that, the whole corpus of R&D policy is not overthrown. The next government will maybe tweak it or develop it in different ways, but it will continue. The institutions continue, the key personnel in the departments continue, and there is continuity.

In Australia, and to some extent in the UK and even more so now in the US, when government changes everyone has to change their positioning as well. In this country we have missions, in the CSIRO and elsewhere, but we also have multiple priorities. And we have challenges. We have all sorts of schemes that are inconsistent with each other across the institutions of government, universities and the Science and Technology Council. Unless we clean that up and say, "Here are the five things we're going to do and we're going to do them really well and we're going to pull all the resources in to make it happen," we'll be in this very fragmented environment where another government could be elected next year or in three years' time and it all changes.

One of the examples that always strikes me is with the Hawke/Keating government: a number of excellent programs were developed in the industrial policy space, especially a program people don't even remember now, called the National Industry Extension Service (NIES), which was a cooperative federal-state joint government program. No-one knew where the money came from: it came from all sorts of places that were cooperating to ensure that it happened, and it was all about capability-building in enterprises and the development of their innovation absorptive capacity, because we're not going to do all the R&D here — we do 2% of the world's R&D. Most of it we will bring in from elsewhere and so enterprise absorptive capacity is a really important thing: are your companies able to adapt, adopt and absorb technology and implement it to improve productivity? And that program? 1996 — Howard government elected. Gone!

Q: Roy, that was a tremendous presentation as always. The question on skills and capability — I'm sitting next to the CEO of Advance.org who looks after a million Australians living and working overseas. We export all this talent, and yet when they come home we give them short shrift, ignore them. They come home either to retire or to educate their children. Given everything you've described, they leave again. How do we change that dynamic so that they can come home and be the entrepreneurs and lead the companies and bring their innovative thinking and stay?

A: Well, it's not hard: mainly having the infrastructure and the money is what it's about. The Irish did this extremely well because they decided in the 1980s they were going to be an innovation economy. Everyone knows the story: they had 17% unemployment, inflation, the economy going nowhere, and some civil servants, together with research institutions, decided, "This is the moment when we introduce policies that will transform our economy forever." So they introduced a foreign direct investment attraction agency especially focused on R&D-intensive FDI. How well do we do that? We don't. They introduced Enterprise Island, which builds up the capability of local businesses to become part of the supply chains of these large companies that were attracted, and not just by tax policy. They built a skills agency, and then the big piece of the puzzle was Science Foundation Ireland which devised policies and programs in conjunction with the universities and large companies to attract back the clever Irish people who had left and were in senior positions in American and European universities. And they asked, "How much will it take for you to run our fabulous new research centre in our university?" When I was a dean in one of these universities, I was involved in establishing a number of these research centres, including a regenerative medicine institute and digital enterprise research institute. "How much will it take to get a top Irish émigré academic from Carnegie Mellon," we asked ourselves, "A million Euro? one and a half million Euro?" Whatever it is, we want to bring you back plus bring a few Germans and Californians with you while you're at it." That's what we did and in a ten-year period the economy was transformed: highest GDP per head in Europe, next to Luxembourg, and a massive shift to high-tech exports.

Q: Roy, I don't want to end on a pessimistic note and I would love to see a policy and architecture like that implemented and I

think you've mounted such a coherent argument, but I must admit to being profoundly depressed. I think Australian business has a culture of rent-seeking that has been in place ever since the country existed. They have governments of both persuasions totally under their thumb. We see it reflected in competition policy. If you look back in history, what really transforms countries is a catastrophe: the Civil War in Britain, the Civil War in the United States, the Great Leap Forward and the Cultural Revolution in China, the destruction of the two world wars in Japan and Germany. That's what leads to this sort of transformation. I don't know what the catastrophe has to be to shake Australia out of its complacency, but it will happen. I hope it doesn't happen with great effect, but it could well be something like climate change. But unless we come to grips with those issues, then I don't think that we will make progress in these areas because no one really is interested. Maybe that would be a good topic for a Forum.

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Inequality in Australia

Address to the Royal Society of NSW on 22 October 2024

Ken Henry AC[1]

Chair, Nature Finance Council

Introduction

Australia has a reputation for egalitarianism. It is not deserved.

This is a nation based on mercantilist plunder. Two hundred and fifty years after the publication of Adam Smith's *The Wealth of Nations* (Smith, 1776), our leaders insist that the prosperity of citizens rests upon a trickling down of bounty from the export of raw materials.[2] This simplistic narrative is told, and retold, by almost every newspaper editor in the country, over and over again, in the form of a Gregorian chant without end.

Economists are uncomfortable with this story. But I wonder how many Australians understand how our celebration of mercantilist plunder has contributed to an erosion of the nation's manufacturing capability, undermined labour productivity growth, and depressed the living standards of workers. I wonder how many understand how this narrative has contributed to growing inequality in Australia, especially as between successive generations.

Australians are aware that the living standards of today's workers are under pressure. They now have lived experience of the impacts of climate change and large-scale environmental degradation. They know that these impacts are getting worse, and that they will be much worse for their children and grandchildren. And they are aware of a growing concentration of wealth, increasingly in the hands of those who have privileged access to the continent's natural resource stocks, and those who no longer must work for a living.

These developments are part of a broader intergenerational tragedy that also features young workers being denied a reasonable prospect of home ownership; young workers burdened by mountains of public debt, the punishing costs of securing a tertiary education and the need to satisfy the increasing demands of "credentialism;" young workers held back by a tax system that relies increasingly upon fiscal drag. Young workers, a declining proportion of the population, are having to pick up the tab.

Why has this been tolerated?

One explanation, voiced often in various groups concerned by what they see happening around them, is that all these things are the consequence of market systems designed by heartless neoclassical economists, prisoners of abstract theories.

That perspective is understandable. But the truth is much worse than that. The

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1 Former Secretary of the Treasury, Australian Government; Former Chair, National Australia Bank. This presentation was the first in the RSNSW Lunchtime series: Provocations and Inspirations, see https://www.youtube.com/watch?v=8RUUFEwI-e4&t=5066s. The talk has been referenced in the *Australian Financial Review* (Kehoe 2024).

2 Smith (1776) rebutted the arguments of the mercantilists, who had argued, inter alia, that a country's wealth derived from its exports (in this case of iron ore, coal and gas). [Ed.]

intergenerational tragedy playing out in Australia could have been avoided had our political system not been so dysfunctional, its leaders less inclined to turn a deaf ear to well-reasoned policy advice drawn from the textbooks of neoclassical economics.

But we shouldn't blame our political leaders either. After all, they are the product of a democratic system. Instead, we need to look at those who elect them; we need to look at ourselves: all of us.

Every generation of Australians since the first wave of European settlement has celebrated plunder, dumb luck, and "finders keepers." This is what we mean by "a fair go." In considering the merits of any policy proposal, every generation of Australians accorded the privilege of suffrage has only ever asked one question: what's in it for me? And because we celebrate plunder, we idolise those who plunder the most. They are our role models.

There is no Australian success story more wholeheartedly celebrated than the export of something taken from nature. Because our political leaders know this, they work hard to be seen to be complicit in these stories. An instructive example is then Prime Minister John Howard's wanting to take some credit for the announcement, on 8 August 2002, of a 25-year Australian LNG supply contract to China.[3] According to Mr Howard, persuading China to relieve us of some of the burden of our natural gas reserves was "a great Australian team effort." Team Australia. All of us.

Two decades later, Australia is the world's second largest exporter of natural gas, and the fossil fuel industry is warning that we don't have enough gas available domestically to heat homes on the east coast of Australia. So, a gas import terminal is being constructed on the NSW coast. Apparently, it should be underwritten by the Australian taxpayer. This is the sort of game Team Australia plays.

It is time to ask ourselves some serious questions about the consequences of our "fair go" ethos. Questions like these: why have we supported a set of public policies that has heavily degraded the natural environment; energised a drift of wealth away from workers, in favour of retirees, property owners and mercantile interests; and entrenched an economic structure that, for two decades, has delivered very low productivity growth and even weaker real wages growth?

Over the first two decades of the 21st century, as productivity growth slowed sharply, the structurally adjusted level of Commonwealth Government spending accelerated, increasing at almost precisely the rate projected in the first *Intergenerational Report*, published in 2002.[4] And, despite the warnings written into the *Intergenerational Report*, the tax system that Australian governments have been relying upon to support that spending is in much worse shape today than it was then. There has been no structural reform of the tax system in the past 24 years. For more than two decades, we have been on notice that our tax system will prove incapable of delivering what will be asked of it. But we just couldn't be bothered.

The present generation of Australians faces a reckoning. This is the first generation unable to make a credible claim that future

3 https://pmtranscripts.pmc.gov.au/release/transcript-12872

4 https://treasury.gov.au/sites/default/files/2019-03/2002-IGR-report.pdf

generations of Australians will be better off than they are.

That's a serious matter. An inability to make that claim threatens a key pillar of the social compact upon which the legitimacy of our democratic system of governance depends.

There is a narrow pathway out of this emergent intergenerational tragedy, and the threat it poses to Australian democracy. But navigating it will not be easy. It will take uncommon leadership that makes the case for this generation not merely asking what is in it for them, but instead, doing what they can to secure prosperity for future generations of Australians.

Political power, national endowments, individual capability and inequality

Inequality in the distribution of political power is a matter that has concerned moral philosophers and economists for hundreds of years. Two dimensions have been the focus of most attention: short-termism and corporatism.

Short-termism is a consequence of the inescapable "fact of life" that only the present generation has access to political power, a fact that necessarily poses a considerable risk to those not yet born. And the unhealthy consequences of corporatism were the principal motivator for Adam Smith's *The Wealth of Nations*.

In his book, *The Price of Inequality*, Joe Stiglitz (2013) draws attention to some of the *capabilities* required of individual agents if they are to be relied upon to generate acceptable aggregate outcomes. And he makes a strong public policy case for the nurturing of those capabilities.

The importance of an emphasis on capabilities has long been articulated by Amartya Sen.[5] The capabilities perspective is central to the Stiglitz-Sen-Fitoussi Commission's report, published 15 years ago, on the measurement of economic performance and social progress (Stiglitz et al., 2009).

Sen emphasises individual capability not only because of its implications for aggregate outcomes, but because individual capability is a matter of primary interest in itself; indeed, *the* primary matter in any discussion of inequality. According to Sen, the core concern should be the extent to which individuals enjoy a set of capabilities that provides them the freedom to choose a life they have reason to value.[6]

The political system can pander to sectional interests for a very long time, as Australia's patronage of its extractive industries illustrates. Yet, it would be prudent to assume that the legitimacy of a political system is fragile. Paraphrasing Sen and Stiglitz, I would venture that trust in democracy is underwritten by a social compact in the nature of a golden rule in two parts: first, all citizens in the present generation should have capabilities that allow them to lead lives they have reason to value; and, second, the present generation, being the only generation with political power, will do what it can to ensure that future generations are even better off.

The capabilities enjoyed by citizens are underwritten by national endowments. Some of these national endowments are a consequence of nature, components of "nat-

5 See, for example, Sen (1992, 1999).

6 This perspective derives from Amartya Sen's exposition of development as freedom (Sen, 1999).

ural capital." Others have been developed by earlier generations of humans. These include the products of foundational investments in such things as: our rich indigenous cultures; modern multiculturalism; the visual and performing arts; our legal and regulatory structures; education and health facilities; systems supporting research and innovation; economic and social infrastructure; physical and financial capital; policy frameworks that promote freedom and economic security; and working conditions that support human dignity.[7]

Investments in national endowments should be designed to expand opportunity and enhance the freedom of all Australians, including those not yet born, to choose a life they will have reason to value.

Capability deprivation provides a powerful explanation for extreme inequality. For example, indigenous disadvantage is overwhelmingly a consequence of a lack of access to the nation's endowments, both natural and created.

And our appalling record of species extinction constitutes another form of capability deprivation with generational distributional consequence: because of species extinction, the present generation, and all future generations, have been denied access to national endowments to which past generations had access.[8]

Of course, equality of access to national endowments does not necessarily mean that all citizens will have the same opportunity and freedom to choose a life they will have reason to value. But a lack of equal access, unless it is calibrated to compensate for all instances of innate disadvantage (in a manner that would be favoured by John Rawls (1971), for example), does mean that some will be denied the capability to choose a life of value. This form of capability deprivation should be assessed both spatially (as among different groups in society, for example) and temporally; specifically, in intergenerational terms.

The foundational role played by natural capital

Human progress, measured in economic or broader social terms, has relied upon models of industrial production, including agriculture, based on the extraction of non-renewable raw materials like iron ore, coal and gas, and the absorption of a stream of "ecosystem services" derived from things like fresh water, forests, marine life, arable soils, and various natural waste absorbers.

How might we assess whether human progress, relying upon these modes of development, is sustainable?

The Brundtland Report (1987) framed sustainable development in intergenerational equity terms: development that deprives

7 National endowments are not the sole determinants of economic, social and environmental outcomes, of course. External drivers and shapers also impact national outcomes. Notable among current shapers of Australian outcomes are the information and communications revolution; global climate change; and the industrialisation and urbanisation of China. And outcomes are impacted, too, by all the current policy settings of government, only some of which would properly be characterised as foundational investments.

8 The endowment in this latter case might be thought of as the opportunity to appreciate (that is, to derive psychic value from) the existence of the species now extinct. As Amartya Sen (2004) reminds us, in the loss of a species there is a loss of opportunity to appreciate its existence. And in that loss of opportunity there is a loss of freedom: a loss of "freedom to have — or safeguard — what (we) value and to which (we) have reason to attach importance."

future generations of the ability to meet their *needs* cannot be considered sustainable.

In an address, economist Robert Solow (1991) offered the perspective that sustainability "is (a moral) obligation to conduct ourselves so that we leave to the future the *option* or the *capacity* to be as *well off* as we are" (my emphasis).

Thus, Solow, too, couches sustainable development in intergenerational equity terms. But his concept of well-being goes beyond human *needs*. It includes an appreciation of environmental amenity, or what he calls "our desire for unspoiled nature."

Solow notes, reasonably, that when we think about our own well-being, or that of our family, our community, or even the well-being of the present generation, we should "recognize that different amenities really are, to some extent, substitutable for one another." Thus, we might see an opportunity for enhanced well-being in trading-off some amount of environmental amenity, some chunk of natural capital, for economic and/or social advancement. For example, we might choose to substitute a year's supply of firewood for the environmental amenity derived from a 500-year-old eucalypt.

These are the sorts of choices humans have been making for centuries: choosing to plunder the environment in the interests of economic and social progress; of individuals, families, and communities. It's been the rational thing to do, an easy choice to make; after all, it's not something any of us has had to pay for, until now.

Today, all the ecosystem services supplied by nature that are critical to human development are facing a set of extreme challenges, from climate change, loss of biodiversity, deforestation, and the collapse of ecosystem functioning.

These challenges pose existential risks to businesses, economies, and financial systems everywhere on Earth. Employment opportunities are being impacted and productivity undermined. Accumulated stores of material and financial wealth are exposed to nature risks so extreme as to be uninsurable. Human cultures, livelihoods and lives are being lost.

So much for sustainable development.

The 1992 Rio Earth Summit conceptualised the sustainability challenge in terms of "integrating and *balancing* economic, social and environmental concerns in meeting our needs" (my emphasis).[9]

This framing has never made sense.

We should have been constructing models of development that acknowledge the biophysical *limits* of a finite planet; models that recognise that those limits constitute a set of immutable *constraints* affecting modes of human development; that the state of the environment is not merely one among many *choice variables* that humans might play around with in various "trade-offs" and "balancing" acts, over and over, without end.

In embracing the language of "balancing" and "trade-offs," policy makers have accepted the notion that human development rests on the continuing plunder of natural capital. It is well past time we understood that securing economic and social development rests upon the rebuilding of natural capital, not its continuing plunder.[10]

This is a matter of primary distributional importance. The rebuilding of natural capi-

9 United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil, 3–14 June 1992. https://www.un.org/en/conferences/environment/rio1992.

10 See (Henry et al., 2023). [Ed.]

tal, often referred to these days as "nature positive," provides an opportunity for this generation to affirm its moral obligation to future generations, to ensure that, in Solow's words, "we leave to the future the option or the capacity to be as well off as we are."

The functional distribution of income

An obvious feature of the capitalist system is that it tends to generate an ongoing accumulation of physical capital through saving and investment. Ironically, the fact that it has tended also to degrade the stock of natural capital has received far less attention from economists than the question of what the process of capital accumulation does to the distribution of income as between capitalists and workers. This "functional" distribution of income was a rather obvious interest of Karl Marx.

In more recent times, the French economist, Thomas Piketty (2014), has argued that because the rate of return on capital has typically exceeded the rate of workforce growth, we should expect to see the distribution of factor incomes becoming increasingly biased toward capital.[11]

Yet, in Australia, the aggregate capital-labour ratio stopped growing about a decade ago and, whilst it experienced a brief period of growth subsequently, has been falling for some years now. This is a consequence of chronically weak business investment.

The behaviour of Australia's aggregate capital-labour ratio can, in part, be explained by the resources boom. But that boom has had an impact on the functional distribution of income through a transmission mechanism that doesn't depend at all upon its impact on the aggregate capital-labour ratio.

At the start of the 21st century, China had about one-fifth of the world's population. Having been closed off from the rest of the world economy for some time, in the last quarter of the 20th century it chose to embrace market economics and international trade. Twenty years into the 21st century it had become the major trading partner of more than 120 countries, being the largest national source of imports into both the European Union and the United States. And it was buying more than a third of Australia's total exports.

Standard international trade theory predicts that a global shock of this magnitude will have a profound impact on the distribution of income, as between workers and the owners of capital, in every trading nation in the world.

Consistent with the theory, China's exports have been dominated by relatively labour-intensive products, mainly manufactures, and its imports by relatively capital-intensive products, especially minerals and energy.

According to standard trade theory, and in the absence of any border tax adjustment, like a tariff on imports or an export tax, we should have expected to see the following pattern of economic impacts in every one of China's trading partners in the developed world, irrespective of whether it ends up being a net-exporter to, or net-importer from, that country: (1) the domestic prices of labour-intensive products like manufactures fall relative to the domestic prices of

11 This is arithmetically guaranteed if all profits are reinvested (which, coincidentally, is what is implied by Phelps' (1961) golden rule of capital accumulation), both capital and labour are paid their value marginal products *and* the (absolute value of the) elasticity of substitution between capital and labour in production is less than unity.

capital-intensive products like minerals and energy; (2) the reward of labour (i.e. wages) falls relative to the reward to capital (i.e. profits); (3) labour productivity falls in all industries; and (4) relative to the owners of capital, workers are unambiguously worse off.

In contrast, Chinese workers benefit relative to the owners of capital.

Of course, there are a lot of other factors influencing relative factor prices, labour productivity, and so on. But those insights from standard trade theory do a pretty good job of describing the real economic impact on all developed nations, including Australia, of China's re-emergence as a global economic power in the first quarter of the 21st century.

As China has opened to international trade, it has experienced persistently large trade surpluses (exports exceeding imports) with the major developed economies of the United States and the European Union. These former manufacturing powerhouses, with large *trade deficits* to China, have had little difficulty seeing a direct connection between China's expansion and a decline in the living standards of their workers.

But Team Australia hasn't got it. To the contrary, we seem to believe that our sales of non-renewable resources to China and other rapidly industrialising nations in Asia have underwritten prosperity for all.[12]

Australia has experienced a persistent *trade surplus* with China.

But the distribution of the gains from international trade, as between capital and labour, has nothing at all to do with the trade balance; it has nothing to do with whether a country experiences a trade surplus or a trade deficit. It is driven, rather, by what happens to the prices of the things the country trades.

China's engagement in world trade has reduced the relative price of labour-intensive products — that is, increased the relative price of capital-intensive products — in all its trading partners.

As the relative prices of labour-intensive products have fallen, the United States and the large manufacturing nations in the EU have experienced modest reductions in their terms of trade. But because we have a comparative advantage in highly capital-intensive resources extraction, especially minerals and fossil fuels, Australia's terms of trade have increased; indeed, as early as 2012, they were double what they had been only a decade earlier.

Large increases in the terms of trade are a big deal for those charged with macroeconomic management.

Increases in the terms of trade fuel domestic inflationary pressures that increase the domestic costs of production relative to trading partners, and an appreciation of the *nominal* exchange rate. Both contribute to what macroeconomists refer to as an appreciation of the *real* exchange rate, an adjustment mechanism that takes the heat out of the economy by damaging the competitiveness of all trade-exposed sectors. Monetary policy can do little to affect the size of the real appreciation. A monetary tightening dampens domestic inflationary pressure but increases the nominal exchange rate. Effectively, the central bank can determine the distribution of the loss of competitiveness as between nominal exchange-rate appreciation and increases

12 This is the mercantilist fallacy. [Ed.]

in the domestic cost of production, but not the magnitude of the loss of competitiveness.

In the decade following the June Quarter 2002, in the first phase of the China-led resources boom, Australia's real exchange rate appreciated by 70 per cent. This had a profound impact on the competitiveness of all Australian import-competing businesses, broadly equivalent to the removal of a 70 per cent across-the-board tariff.

Over that decade, hours worked in Australian manufacturing fell by 10.3 per cent, falling from 11.4 per cent of total employment to 8.4 per cent. Over the past 20 years, Australian manufacturing has lost about 200 workers a week.

Between 2002 and 2012, mining's share of total employment, measured in hours worked, increased from 1.1 per cent to 2.1 per cent.[13]

You will probably recall that as mining exports were accelerating, our political leaders were wringing their hands over Australia's "two-speed economy." But they refused even to wonder whether the damage being done to those in the slow lane might have had something to do with the frenzy of activity in the fast lane.

The damage done to Australian manufacturing by a 70 per cent appreciation of the real exchange rate in the first decade of the 21st century could have been avoided — for example, by levying a tax on the exports of non-renewable natural resources.

The Australian Government still has an opportunity to levy a tax on our fossil fuel exports, reflecting their embodied carbon. If we don't do it, importing countries will, eventually. For example, the European Carbon Border Adjustment Mechanism (CBAM) has been designed to do so. A fossil fuels export tax levied at today's European carbon price would add many tens of billions of dollars a year to government revenues.

For an economist, it is beyond irony to witness today's leaders turn to jelly when confronted with a claim that attending to the environmental risks posed by a new mining proposal will destroy hundreds of jobs, knowing that those same leaders have done nothing to prevent the loss of hundreds of thousands of jobs in manufacturing over the past two decades. And it is simply obscene to see some of them now posturing as champions of a "made in Australia" manufacturing strategy.

But what about the impact on the living standards of Australian workers generally of China's engagement in world trade? What matters here is not whether a country's terms of trade have improved or deteriotated, only what has happened to the domestic price of labour-intensive products relative to the domestic price of capital-intensive products. Thus, even though Australia's terms of trade have moved in the opposite direction from those of the US and the major EU countries, workers in Australia have been affected in precisely the same way: labour productivity has fallen, or grown more slowly, in all sectors, and the living standards of domestic workers have declined relative to the owners of capital.

Since Australian exports are relatively capital-intensive, a doubling in Australia's terms of trade implies that, in the absence of any border tax adjustment, the relative domestic prices of labour-intensive products fall on average, by about 50 per cent. No

13 ABS, *Labour Account Australia, June 2024*. The data are seasonally adjusted "hours paid for."

other developed economy has experienced such a large negative shock to the living standards of its workers.

Note that this shock doesn't necessarily translate into a declining share of wages in gross domestic product. That's because GDP growth is also negatively impacted by weaker labour productivity growth. Thus, labour's share in GDP was 48 per cent in the June Quarter 2002 and in the June Quarter 2012.

Over the decade from the June Quarter 2002, Australia experienced staggeringly poor annual labour-productivity growth, averaging less than 1 per cent, underwriting anaemic — in some years even negative — real-wages growth. All sectors of the economy have been affected. Some will find this hard to believe, but labour productivity in the mining industry, measured by real gross value added per employee, fell by 46 per cent over the decade from the June Quarter 2002. And that has nothing to do with mining-related construction activity.

Standard trade theory says this is what should have been expected. The damage done to the living standards of Australian workers, through its impact on labour productivity growth, is not a consequence of systems designed by heartless economists, prisoners of abstract neoclassical theories. To the contrary, it is due to the steadfast refusal of legislators to take any interest in those theories.

And it is not merely neoclassical economic theory that supports a conclusion that the resources boom has undermined Australian productivity growth. One only need take a cursory look at the data. According to my calculations, the resources boom explains two-thirds of the deterioration in Australia's productivity growth performance so far this century relative to the last three decades of the 20th century (refer to the Appendix).

Capability investments in the Asian century

A focus on national endowments illuminates the need to ensure that Australians are endowed with the capabilities that will be relevant to success in the Asian century. Success will come from integration based on complementarity, not from a race to the bottom in wages, social foundations or environmental standards. In managing the risks of growing Australian inequality, there is a need for new foundational investments, including public investments: in our schools, universities and vocational training centres; in developing Asia-capable workplaces and institutions; and in encouraging adaptability.

The case for making these investments was set out in some detail in the *White Paper on Australia in the Asian Century*[14]. It explained how past capability investments provide a contemporary basis of comparative advantage. These capabilities include: excellence in governance; relatively low levels of corruption; safe working conditions; a concern with environmental sustainability and animal welfare; and institutions that support social harmony, economic and social opportunity, and tolerance. All these attributes support opportunity and freedom for this and future generations of Australians. They improve the wellbeing of the Australian people by enhancing their prospects of choosing a life they will have reason to value.

14 https://www.eastasiaforum.org/wp-content/uploads/2014/04/australia-in-the-asian-century-white-paper.pdf

But a mercantilist will argue that all are costly; that Australia's international competitiveness would be improved by ditching them. And let's not kid ourselves: all are at risk. Upon election of the Abbott Government, every discoverable printed copy of the Asia century white paper was literally pulped, and every government supported digital link to it was severed.

The structure of taxation

The tax review commissioned by the Rudd Government, early in 2008, provided an opportunity for a group of tax policy experts to consider how the tax and transfers systems might best evolve to meet the challenges of the 21st century, and to underwrite future prosperity.[15]

The review team identified challenges associated with strong population growth and population ageing; the Asian century; climate change and widespread environmental destruction; and developments in digital communications and commerce. We called out worsening housing affordability as a matter much in need of policy attention.

Our review identified the several potential sources of revenue: labour income; the normal return on capital; transactions; land; consumption; wealth; natural resources; windfall capital gains; economic rents; environmental externalities, including carbon emissions; and user charges.

We noted that placing reliance upon the first three — labour income, the normal return on capital, and transactions — put at risk the living standards of future generations by retarding productivity growth and workforce participation. We argued the case for reducing reliance on these sources and placing much greater emphasis on all others.

But understanding these things and convincing others of them are very different exercises. A nation that celebrates plunder and dumb luck, and respects "finders keepers," will not easily see a case for extracting more revenue from natural resources, windfall capital gains, economic rents or environmental externalities. It will have no tolerance of land taxes or other taxes on wealth.

The GST commenced operation on 1 July 2000. We haven't managed to sustain any tax reform effort since. There have been attempts, and they have failed. The tax-mix switch achieved with the introduction of the GST was undone in two decades, with indirect taxes contributing the same share of total revenue as in 1997–98. We are back to where we were in the several decades following WW II, that led ultimately to the Asprey Review: ill-disciplined government (which is funded by fiscal drag that punishes innovation, enterprise, and effort) is relying on a tax system that distorts the pattern of saving, and rewards tax avoidance and evasion.

The Asprey Review warned that placing exclusive reliance upon fiscal drag in the personal income tax system would threaten the social compact. There is a bigger risk now. Over the second half of the 20th century, the share of working taxpayers in the population grew strongly. Today, demographic trends are reducing the working share of the population, and the share that will be paying income tax. A heavier and heavier burden is being placed on the shoulders of a declining proportion of the population.

15 https://treasury.gov.au/review/the-australias-future-tax-system-review/final-report

There is a lot that can be said about much needed reforms to the Australian tax system. And the tax review published in 2010, devoted 1,000 pages of text to that end.

One thing worth keeping in mind as we think about tax reform requirements today is that, when we were working on the project through 2008 and 2009, we were confident that the Rudd Government's world-leading climate policy would be legislated. Its absence implies the need to explore ways in which the Australian tax system might best contribute to reducing carbon emissions and removing past emissions from the atmosphere. This is not the occasion for talking about these things, but they must be top of mind in any tax reform discussion.

Almost all the historical discourse on the fairness of various tax reform proposals in Australia has been framed in intragenerational terms; usually evaluating comparative static changes in progressivity, with current income as the denominator. In that framing, many of the much-needed reforms to the Australian tax system will be labelled regressive.

I would make two points here.

First, the interests of the most disadvantaged are not being served by a tax system that is punishing innovation, denying people opportunity, undermining economic growth, and threatening the sustainability of government service provision.

Second, and more to the point, the present tax system amounts to a conspiracy against future generations. If this generation is to make any credible claim that future generations of Australians will be better off than we are, then far-reaching tax reforms in the directions spelt out here are unavoidable.

Appendix: Australia's terms of trade and labour productivity

Looking back over the 21st century so far, there is likely to be a significant trend in Australia's productivity data, for a host of reasons that could be difficult to isolate. And the time series for productivity is also affected by large shocks, like the global financial crisis and COVID-19. But Australia's terms-of-trade were also shocked by the global financial crisis. And, if there is a strong inverse relationship between the terms-of-trade and productivity, then the global financial crisis should illustrate that relationship.

I am prepared to speculate that, in the period between the onset of the mining boom (the end of 2003) through to the onset of COVID (say, the end of 2019), most of the "other" impacts on labour productivity (i.e., other than terms-of-trade effects) might be captured in some well-behaved trendline; maybe not linear, but why not start there? So, I have deployed OLS regression on the quarterly time series data for this period (65 observations in each series; indices, Dec Qtr 2003 (t=1) = 100), returning the following estimated linear equation:

$$\pi_t = 104.0278 + 0.3372t - 0.0472p_t,\ R^2 = 0.9741$$

where:
π_t: the level of productivity in quarter t
p_t: the level of the terms-of-trade in quarter t
$t = [1,2,3,\ldots,65]$

All coefficients are highly statistically significant (with vanishingly small p-values).

Stripping the estimated linear trend contribution from the raw productivity data produces the time series shown in the blue line in Figure 1.

This looks like something worth thinking about. It does pose a bit of a challenge to the narrative that the resources "boom" has underwritten Australian prosperity.

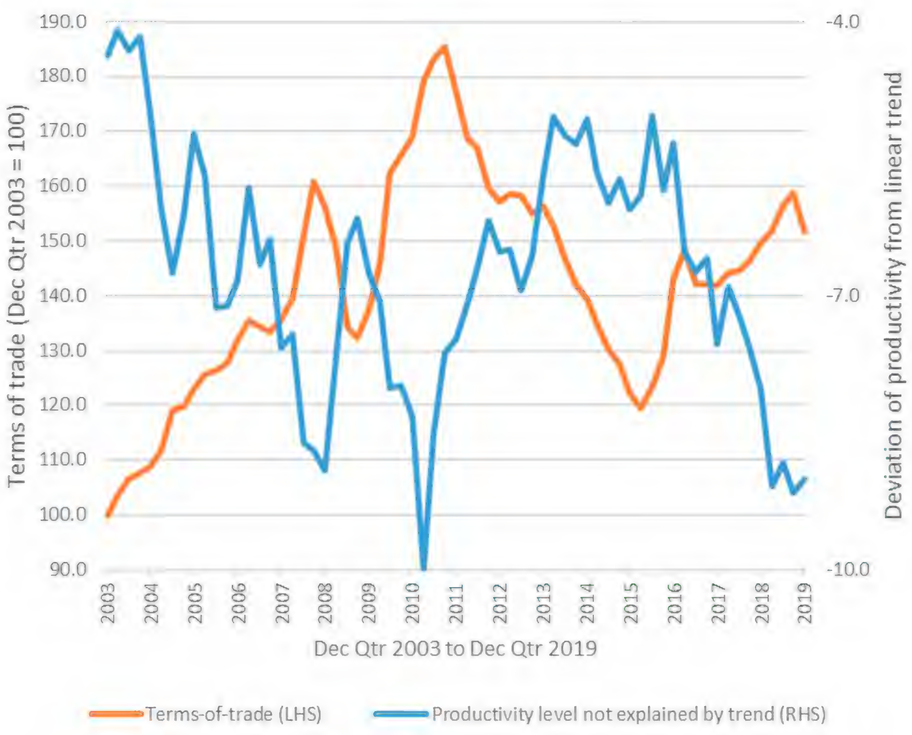

Figure 1: Terms-of-trade and actual productivity level not explained by linear trend

What if?

So, what if the terms-of-trade had not accelerated from the Dec Qtr 2003 through to its post-GFC peak in the Sep Qtr 2011?[16] Well, the coefficient on the terms-of-trade in equation (1) implies that, all else equal, the average rate of productivity growth over those eight years would have been 0.53 per cent a year larger; that is, 1½ per cent a year, instead of the actual average rate of a little under 1 per cent. For reference, Australia's average annual rate of productivity growth across the last three decades of the 20th century was 1¾ per cent.

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16 The terms-of-trade increased well above this level in the years following.

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Questions and answers

RG: About the same time as we rejected a 20% resource rent tax (RRT), Norway imposed a 76% RRT on their oil and gas assets which was then used to create the world's largest sovereign wealth fund. What would Australia have looked like had we done something like that?

KH: Well, we would still have a vibrant manufacturing sector. The very first piece of economic advice I ever gave to the incoming Rudd government in November of 2007 was to put a big tax on resource exports. Of course, they laughed. How could a mercantilist tax exports? Are you crazy? A couple of years ago, you'll recall we had an angst-ridden discussion in Australia about what was happening to domestic gas prices. Simple high-school economics tells you that if you want to have domestic gas prices lower than world price and you are the second largest exporter of gas in the world, put a tax on your gas exports, for God's sake. It's not hard. It's pretty simple stuff, right? By the way, our gas exports will one day in the not too distant future be taxed, but not by us — because we're stupid mercantilists — they're going to be taxed by the European Union under their CBAM. They've already told us, and they've told us when it's going to start, and taxed by all of those other countries that we export to that are going to copy the European Union's CBAM. I would predict that we are too stupid and too locked in this mercantilist mindset — this narrative of Australian development — to understand that we should tax them here before they leave Australia.

Am I talking about something consequential or not? You asked about the Norwegian sovereign wealth fund. It's only back-of-the-envelope calculations but, as I said above, that tax at the present CBAM shadow price (which is really the price at which carbon credits are presently trading in Europe) would generate for Australia tens of billions of dollars a year. Why is that number so big? Well, the carbon embodied in Australia's fossil fuel exports is three times what we count as emissions from all sources: we don't count the carbon embodied in the stuff that other people buy from us in our national emissions. That's why the number is so big. I reckon the Norwegian sovereign wealth fund would be absolutely tiny relative to Australia's sovereign wealth fund.

I remember on many occasions as the mining boom was getting underway appearing in public forums and being asked the question, "Why doesn't Australia have a sovereign wealth fund?" I was always a bit surprised by the question because we were incapable of putting a tax on even just supernormal profits from the mining sector. A country that lacks either the intelligence or the courage to be able to do that, which is a rather obvious thing to do, should stop dreaming about sovereign wealth funds, certainly anything approaching the Norwegian scale.

RG: On that note, Equinox are going to invest in offshore wind in Australia and I asked them how much tax they paid last year. €80 billion, and they were still making a profit.

Q: Could there be anything more unequal than the huge lobbying sector which makes huge profits for people who employ so many

lobbyists? How will we break this nexus because basically all these questions about why we're not doing things come back to the decision makers and the decision makers' perspective on things is being incredibly influenced by these organisations?

KH: It's true and of course I've had the opportunity to see it first-hand, with 28 years of policy advising in Canberra. It's actually what I referred to in Joe Stiglitz's 2013 book. It's actually what Adam Smith refers to in *The Wealth of Nations* (1776) — it's those with economic power who have the opportunity to exert political power, and the use of that political power gives them more economic power and round and round it goes, in this destructive cycle of increasing economic power, increasing political power, and so on. It has to be broken. But it's not surprising that it happens in a democracy, where political parties need to compete actively against one another — I used to think that this was only something that happened during election campaigns, but when I was working in Paul Keating's office as an advisor, which I did for five years, the ethos in the office was that you had to win the debate for the parliamentary term and that included being seen to be successful in introducing and getting legislation passed. By the time Rudd became prime minister it was every 5 minutes of every day — you had to be winning.

It's not just the politicians who are under the heavy influence of economic power and reliant upon donations from those who have the economic power — there are also the media: in the debate that we had around the resource super profits tax, I was treasury secretary at the time. I was so annoyed — it was the only time in my life that I ever did it — I called the editor of the *Financial Review* and said, "You're a joke, mate, what the hell are you doing?" Because the editorial line that was being written was the Australian mercantilist narrative — that exports of fossil fuels and iron ore are the source of Australian prosperity and only a dumbass would want to put a tax on this stuff; this amounts to killing the goose that's laying the golden eggs. His response was, "Well, every business we talk to — I guess he meant the Minerals Council — tell us that this is crazy." The role of the media is meant to be to call this stuff out, not to be complicit in it.

RC: One of the key things you framed in your talk was a lack of political will and a failure of democracy. What's troubled me in observing our political processes is the breakdown of the Westminster-style two-party system and the emergence of the smaller parties being able to hold to ransom, as it were, to achieve some kind of political concordat to break through in an electoral sense. It's how we manage that need to have the political will to do the wonderful or brave things of which you've spoken. There is also the way that the media can misdirect, courting a kind of cheap popular spirit. One of the examples is our failure to maintain public housing stock over decades, and then suddenly to point the finger at all these immigrants as somehow to blame for a lack of access to housing. It's a combination of political will, change in the democratic structure and misdirection in the press.

KH: It's a great question. I know what you're talking about with public housing. I grew up in a public housing suburb, although for some reason we didn't have a public house, but we were pretty poor — my father was a timber worker on the lowest award rate of pay in the nation — all of my school friends

were living in public housing. Our lack of investment in public housing is a disgrace.

On the media: I think it's kind of interesting to see editors of established newspaper names — I say "established" but it doesn't mean they're going to be with us much longer — drawing a distinction between the traditional media — or apparently those that you can trust — and those that are threatening their existence. That's principally social media. I don't trust much that I read in the so-called traditional media; I've stopped subscribing. Maybe it's because they think the only way they can survive in this world of a hyperventilated contest is to be a participant in it and not to be different. That's how it looks to me. All those newspapers are getting thinner and thinner, except for the advertising. If the traditional media thought that they were going to be able to continue to distinguish themselves from social media, they wouldn't have started to ape them. I did ask an audience not that long ago, "When was the last time you ever read any news in a newspaper, I mean news you weren't aware of until you read it in the newspaper?" What you get in the newspapers today is commentary at best; mostly opinion — whether it's fact-based or not, it's opinion.

I don't have the answer to that but I will say this: coming back to the dysfunctional democratic system and the minor parties — Peter Shergold will remember this very well — we've had minor parties holding the balance of power in the Australian political system for a very long time. As a public servant, you had to ask yourself a lot of questions, but two in particular. One, is there any chance at all of getting this legislation through the upper house? And then the second, which is a rather more challenging question for a public servant to ask but nevertheless you do have to ask it: do we have a political leader capable of running the argument publicly?

DE: We hear of the cost of living crisis and the housing crisis. If you were prime minister, how would you solve both of those?

[Laughter]

KH: We've already had one suggestion on the housing crisis: public housing. There's no point in pussyfooting around on this one: capital gains tax preference for the family home: a $10 million house, or could be a $50 million house, sitting there on the Harbour. No capital gains tax at all. It doesn't count in the assets at all. That is one issue. The popular debate on the relationship between the tax system and housing affordability goes to the issue of what's called negative gearing. There's nothing special about somebody who owns an investment property being able to deduct the expenses associated with that investment property including mortgage interest against income from any other source. What makes negative gearing attractive is the capital gains tax, which you are expecting to pay. If you look at the rental yields that landlords get, once you take out property tax, they're in the region of 2 to 3%, which only makes sense if they are expecting a large capital gain to make up the difference to other investment opportunities. But the way the capital gains tax works is, first, you don't pay it on an accruing basis — I'm not suggesting you should: I understand the difficulties associated with that — and, second, they're not just theoretical but quite practical. Only one half of the capital gain is assessed as taxable income and taxed at your marginal rate. You don't need a very high rate of capital gain for that tax preference to be sufficiently attractive to explain why

negative gearing is so popular. Australia is a standout internationally in the attraction of rental property as an investment class, relative to countries we normally compare ourselves with. It mostly has to do with those two things: first, lack of adequate public housing as an alternative for low-income rental and, second, the way the capital gains tax system works.

The proximate cause of the cost of living crisis is the wash-out from the COVID pandemic, which disrupted global supply chains in a way that nobody had foreseen. It's quite remarkable how quickly we turned from celebrating the Japanese just-in-time industrial model into "Oh my God, this is posing an existential threat to humanity," which it kind of does. We hadn't thought about the risk. COVID disrupted the supply chains, and in standard simple economics, the supply curve shifts to the left. If the demand curve doesn't shift, you'll get higher prices and inflation. What the Reserve Bank has been doing is trying to shift the demand curve to the left so that you don't get price inflation, but you do get a fall-off in economic activity. The RBA's ability to achieve that outcome without securing a recession is quite remarkable, but it does beg the question whether it might not have been prudent to wait to allow some of the adjustment to come through on the supply side.

But monetary policy can only do so much because you need to get the supply curve to shift to the right. For that, you have to be paying attention to the sources of productivity growth, for example. So maybe you should start looking at reforming the Australian taxation system in a way that drives productivity growth. That would generate two benefits that would help to address the cost of living crisis: first, it takes the pressure out of prices, and second, it provides the underpinnings for real wages growth.

GM: You mentioned how our kids are going to have the sort of opportunities that we had. Historically, there have been three sources of comparative advantage for Australia. First, the minerals sector — maybe productivity has been declining, but in an absolute sense we do pretty well at digging things up. Maybe we should process more. Second, the agricultural sector has always been important. Third, education has become quite important. Looking at where the comparative advantage for Australia might lie, how are we going to create these opportunities? Where are we going to look for employment growth, just looking at the underlying economics? Where are those opportunities going to come from?

KH: A couple of things. First, the sectors that you referred to as being sources of comparative advantage for Australia have never been drivers of employment growth. The mining sector has never employed more than 2.5% of the labour force, and that was in a boom time. Historically, it has employed between 0.9% and 2.1% of the Australian labour force. Mining has been a great driver of exports, but it has distributed very few benefits to Australians because very few Australians work in mining. In the national accounts, there's only one thing that has a higher capital-to-labour ratio than mining, and that's something called "ownership of dwellings." That's because it's got no labour in it; it's all capital. But if you ignore ownership of dwellings, mining has a capital-labour ratio that is several multiples of anything else. It doesn't contribute to the living standards of Australian workers, and at least three-quarters of the shares in the big multinational companies that exploit Aus-

tralia's natural resources are foreign-owned, so foreign capitalists get most of the benefit. Some does come to Australian superannuation funds and beneficiaries, although Australian superannuation funds have long acted on the basis that they can get higher returns offshore than in Australia. Even in the middle of the global financial crisis, they were investing 35% of their assets in foreign equities, mainly in the United States. So we must ask ourselves more fundamental questions, and some of the answers you suggested are right. We do have to look at our education system and at building what I call Asia-relevant capabilities. In the Asia-Century White Paper, we had the Australian government signing up to a proposition that by some year every Australian school child would have the opportunity to learn an Asian language. Where did that go?

It is not too late to turn some of this around, but I don't see any of our current politicians capable of constructing a narrative that would carry the day. If I were prime minister, I would actually put a tax on Australia's fossil fuel exports equal to the rate the Europeans are going to tax them at within two years' time. I would raise tens of billions of dollars a year and I would spend that on national development — rebuilding the productive capacity of the country — and I would do more than that. With respect to meeting our own Net Zero by 2050 ambition, I would direct very substantial amounts of funding to rebuilding the quality of natural capital across Australia, including in heavily degraded farming areas. I know how to do it: a group of us have modelled this piece of policy work, as good as anything in the world. I know a way through our carbon policy to generate $10 billion a year to invest in nature repair across the Australian landscape, most going to farmers. We can do these things; they're not that complicated.

IS: I want to ask about taxation. I think that many of us in this room are drawing pensions. It is ridiculous that we don't pay any tax on pensions. That's something I never hear about because it's probably so unlikely. I know the grey vote is very important, but I think pensions should form part of taxable income.

KH: They do for me because I'm one of those lovely public sector superannuation schemes. There's a lot in it. When you consider the taxation of superannuation, there are three taxing points. One, there's how much tax is paid when wages and/or salary or any other form of income are sacrificed and instead of being used to finance current consumption are directed into this tax-preferred savings vehicle called the superannuation fund — that's the contributions tax. Two, there's the tax on the fund earnings: how does that taxation rate compare with the taxation rate on a bank account balance or dividends or rental property investment or whatever, all of which apart from the bank account are tax-preferred?

Three, there's the one that you mentioned, which is when you make a withdrawal, how much tax do you pay? Now, when you withdraw money from the bank account, you don't pay any tax. Firstly, it's because when you put the money into the bank account the assumption is that it was fully taxed income, and you're only putting money in out of taxed income; secondly, the interest income is fully accessible whilst it's in the bank account and so it would be madness to tax it on the way out as well. But how does superannuation compare with that? It's obviously tax-preferred. Like a bank

account, there's no tax on what you take out. There is a concessional rate of tax on the contributions going in, although that's no longer a single rate of 15% and depends upon your income, and there's tax on the earnings inside the superannuation fund, and again, that's not a single rate of tax: that also will depend upon the account balance. But curiously — here's the thing that I really do not understand — if you are a pensioner like yourself getting money out of the superannuation fund, then what I've just said about the earnings is not true. They're actually exempt from tax: the earnings inside the superannuation fund are exempt from tax. You're drawing a pension in the pension phase. I have never been able to get my head around that. I cannot understand that one at all. It makes life rather complicated for the superannuation funds because they have to decide which of the earnings are referable to which pool of assets that are referable to the pensions being paid out, and which are not. Anyway, we've created that system. In the tax review, we recommended getting rid of that exemption so that all earnings are subject to tax, and then, if you want to reduce the concessionality of the superannuation system, you either work with the contributions tax or the earnings tax, or you think about a more comprehensive wealth tax, but we didn't recommend it. We just said to think about a more comprehensive wealth tax, and that might be the only way of achieving the level of equity or fairness that you referred to.

DH: You referred just a moment ago to wealth tax in the Henry Report but no recommendation, just saying there should be a public debate. You also referred to Piketty's work, which says that the returns to capital are greater than the returns to labour. Australia has done something of a job in rectifying that by making everyone who has a compulsory superannuation account a capitalist. I recently did a back-of-the-envelope calculation: if you taxed at 5% the top 200 wealthiest people in Australia, you could put $5,000 a year into savings accounts for every single child in Australia. If you did that from the date that they were born until they turned 18, they'd have nest eggs of about $100,000 each, which could very well make the difference between owning a house by the time they retire and not owning a house. Any ideas on wealth tax generally?

KH: You're right. When we wrote the review, we referred to wealth taxation, but we didn't make a recommendation. We did say there was a need for public debate on a wealth tax. We haven't had it, although maybe you could argue that the housing affordability crisis is some form of debate on a wealth tax, but I don't think it is really. I think there is a need for Australia to have that sort of debate on a wealth tax. I don't know what the public appetite is. I'd like to see it tested, but I don't know. I think it's because of what I said earlier — maybe there are other explanations for the way that we have behaved as an electorate over many years — but I really do think it is the case that we interpret "fair go" as plunder, dumb luck, and finders keepers, and you should never take any money away from somebody, no matter how they got it, unless it was through criminal activity. The celebration of plunder: I was kind of shocked when I witnessed first-hand the efficacy and the power of the Minerals Council's campaign against the resources super profits tax — the biggest, most profitable companies in Australia — and a government that was in reasonable political

position at that time. So there is something in the Australian psyche that does not like to see wealth taken from anybody. I've often wondered how much of this goes back to the Eureka Stockade. The reason I say that is it was not until 1987 that any activity associated with gold mining paid 1 cent of tax. One of my distant relatives, long gone past, is associated with the Stockade and ended up being Minister for Mines in Victoria; he also started the *Daily Telegraph* here in Sydney. That explains a lot.

Q: I am wondering if you might comment on the prospect or realistic hope of some sort of loose alliance between government or involvement by government between those market forces that might provide a counterweight to the kind of interests or mindset that you've described, and civil society as well. For example, the farmers in that natural capital example you mentioned presumably are a kind of political economic voice or power that could be brought to the fore. But the renewable sector — you can go on and on — manufacturing sector. Do you see any realistic sort of prospect of a counter movement?

KH: Great question. What's implicit in your question is that it must be possible to marshal those interests who benefit from change to be a force for good rather than a force of opposition. Here's something to reflect on. About a month ago, the Climate Change Authority released its report on its carbon projections for the six sectors that make up the Australian economy: what will happen to the carbon emissions out to 2050 under the government's six sectoral decarbonisation strategies that they're developing independently. Just a little bit about the composition of Australia's carbon emissions at the moment. As you know, the landscape naturally sequesters carbon: if you just leave it alone, it will absorb carbon in the growth of vegetation, grasses, and soil and peat, and all that kind of stuff, right? That's how the carbon got there in the first place before we interrupted. That's a natural process that in Australia today is sequestering 90 million tonnes of carbon a year, but everything else that we're doing — including the cows belching methane but also all the industrial processes — and excluding all the carbon embodied in the fossil fuels that we export and get somebody else to burn rather than us contributes 520 million tonnes of carbon a year to our emissions. So our net emissions are 430. That's our starting point when we say we're going to get to Net Zero by 2050; we're saying that 430 has to get down to zero. So the Climate Change Authority has asked itself this question: let's forget about the land sector for a moment; where do we think the five other sectors plus agriculture are going to end up by 2050 if the government does everything that the government appears to be wanting to do and we make use of every known technology, etc.? Answer: they reckon that we can get the 520 down to 130. That's pretty incredible. But the other way of looking at it is that land, instead of absorbing 90, is going to have to absorb 130 million tonnes of carbon a year. Actually, that's a bit of a fiddle on my part because they do say, "Oh, but it won't have to absorb as much if we combine some new technology that can draw carbon out of the atmosphere like direct capture." Unless you can find some new technology of that sort, then the agriculture sector is going to have to absorb 130 million tonnes, the length rather than 90. That's a big increase in carbon sequestration in the Australian landscape. I look at that and I say, "Fan-

tastic opportunity — a new revenue stream for farmers." The president of the National Farmers Federation obviously had the press release loaded in the barrel, so as that report came out, the press release bang — it was out and it said, "No way are we having more trees across Australia's farms." I still agree with you; we're going to have to talk to farmers and the National Farmers Federation, but it's not easy.

CS: We could not have had a better case of a public intellectual contributing to civil society than you've given us today. I wanted to say just one slight personal note: my mother was an economist in Peter Karmel's group at Flinders, and just before she died in 2009 she said, "Look, things are going to be okay: wholesale reform of taxation — the white paper is out. Thank God, it's going to be fine." Very sadly, she died at the end of that year, but I've always felt glad that she thought we were going to be okay. I'm just amazed at your ability to come across these wide areas. I remember reading you saying somewhere that fuzzy concepts can be measured. Now, I didn't do economics; I went into logic, and I used to do fuzzy logics. We had fuzzy logics that went fuzzy all the way down. There are much better mathematicians than me here who could explain it, but what happens with you is that you're not fuzzy all the way down. I've never heard such clarity of talk, and again it takes me back to Karmel and Wallace and Harcourt around the dinner table. They used to talk deep into the night, always with this combination of a sense of social responsibility, looking for the good of society. Very clever economists but with this clarity and sense of responsibility, which I think is even more important now than ever. I also want to say something about your turn of phrase, which is just extraordinary. I started writing them down as you got going, and then my scribbles got incomprehensible, but certainly "a fair go is plunder, dumb luck, and finders keepers." I don't think any of us will ever forget that, or we idolise those who plunder the most, and quite a lot of your other unbelievably elegant phrasing I think has helped us. I think we have come out of this with a sense that at least we've got people thinking through these questions and dealing with them. From our point of view, I think that's what we think we have to do. So I'm extremely grateful, and I'd like you to accept a copy of the history of the Royal Society, which has tried to address these issues — not always in the best way; we've got some pretty black passages in our history, in particular in dealing with Indigenous people — but it's a story of people who are trying to do the best. So thank you very much indeed.

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How a single letter changed the world: W×3 – the World Wide Web (we weaved)

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Welcome from Her Excellency, The Honorable Margaret Beazley, Governor of NSW

As is our tradition at Government House, I welcome you in the language of the Gadigal: *Bujari gamarruwa Diyn Babana Gamarada Gadigal Ngura*. I pay my respects to their leaders, past, present, and emerging, as well as the Elders of all parts of our State from which you have travelled.

To say that computer technology has engulfed our world is like telling this audience in particular that Planet Earth isn't flat, although I can confirm that membership of the Flat Earth Society is free and joining up is simple. As of 2010, it had 189 members — at least, that's what I learned from Google.

I would also posit that even in this learned audience, some would be surprised at the extent to which computer and digital technology at the best, and often the very best, facilitates, but at the worst, controls, not only human interaction but many aspects of the everyday functioning of our society. This phenomenon is sometimes referred to as the Fourth Industrial Revolution. My own sense is that we are actually in an era of incomparable change.

Many benefits of this new era would have been unimaginable in 1822 when John Babbage, with funding from the Royal Society of London, designed what many consider the first computer,[2] and possibly not even in 1973 when the first commercial microcomputer, the Micral N, came onto the market.[3] Today, many of these benefits are aspects of everyday life to which we give little thought — digital phones, the internet, Google (that ready-at-hand encyclopedia of anything and everything), robotic surgery (which some of you here may have experienced), the ServiceNSW app and its QR code that got us through the doors of department stores during COVID and facilitates the renewal of our car registration, drivers' licences, and the payment of some of our taxes, internet banking, and, even more exotic, technology such as robotic security guards and robotic receptionists.

AI infiltration of the creative arts space has raised concerns of a different nature. As a teaser, I suggest you Google "Queensland Symphony Orchestra and AI" and read the associated articles to understand how AI can operate.

These and other challenges of technology, including its worst aspects, will undoubt-

1 This paper is the transcript of a presentation in *Ideas@theHouse*, Government House, Sydney, 18 July 2024. See https://www.youtube.com/watch?v=nSFVrIugy3E

2 https://science.howstuffworks.com/innovation/inventions/who-invented-the-computer.htm

3 https://blog.wirelessmoves.com/2019/05/the-micral-n-and-others-the-micros-before-the-altair-8800.html

edly be the subject of interesting discussion tonight. By way of introduction, I would like to briefly refer to the reach of technology in areas that may not be so familiar to you. It's somewhat of a shopping list, and I won't dwell too much on the detail, but I found it interesting.

Recently, AI Steve, an AI chatbot, ran for Parliament in the constituency of Sussex, encompassing the towns of Brighton and Hove, in the recent UK elections under the banner of the SmarterUK Party[4] — I kid you not. AI Steve's human counterpart was Steve Endacott. The concept involved AI Steve having conversations with voters in Brighton and Hove, to ascertain the concerns of as many constituents as possible, and many more than traditional door-knocking would reach. If elected, the real Steve would represent AI Steve in Parliament. The real Steve explained that this campaign was a human-AI collaboration and described AI Steve as his co-pilot. AI Steve garnered 179 out of the 52,572 votes cast, so while not elected on this occasion, AI Steve might well say: "But, watch this space."

The tech company OpenAI, the maker of ChatGPT, recently discovered five operations based in Russia, China, Iran, and Israel using its technology to manipulate public opinion.[5] By this year's end, there will have been more than 64 elections worldwide: two recently concluded in France and Britain, and, of course, November 5 in the USA is just around the corner.

OpenAI instanced an example of an Israeli company called Stoic, which used OpenAI's technology to target social media accounts with pro-Israel content about the war in Gaza. Regardless of whether or not this involved fake news — and I have no way of knowing — it was at least a myopic representation of a very complex situation, demonstrating the danger of the misuse of technology, particularly to an illiterate and unsuspecting audience. The impact of the threat of AI on political influence is much more than a ripple on the surface of already troubled waters.

Law enforcement has become another area where technology is frequently used. In the US, one county has introduced a software product to draft police reports based on auto-transcribed audio from body-worn cameras during police operations. These reports, at the moment, are restricted to minor incidents and it is claimed that this will significantly increase police efficiency, given that individual police officers in the United States can sometimes spend up to 40% of their time writing up reports. The claim is that this "will prove to be one of the most impactful innovations of our time to help scale police work and revolutionize the way public safety operates."[6] We can hope, but we might have to wait and see on that one as well.

In New South Wales, child pornography is subject to a classification system from 1 to 5. Any form of child pornography is serious, but the level of depravity involved at the

4 https://singularityhub.com/2024/06/13/say-hello-to-ai-steve-the-chatbot-running-for-uk-parliament/ and https://theconversation.com/britains-first-ai-politician-claims-he-will-bring-trust-back-to-politics-so-i-put-him-to-the-test-233403

5 https://time.com/6983903/openai-foreign-influence-campaigns-artificial-intelligence/

6 https://www.policemag.com/technology/news/15669250/axon-introduces-aipowered-automated-police-reporting-tool

higher end of the classification is beyond any reasonable sense of human comprehension. The impact on the police officers undertaking the classification is really shattering, and we've spoken to many of them. AI is now being used to classify the material in the first instance, subject to human verification. The reduction in the amount of material that has to be physically viewed by police officers is significant, with a corresponding benefit to the mental health of the officers undertaking this onerous but absolutely essential work. But it also needs to be said that technology has been the great enabler of the proliferation of child pornography in the first place.

Fortunately, for every technological advance, one can find the ingenuity of human or even anthropomorphic intervention. Australia now has 13 technology-detection dogs, not to track your Google usage but to detect various tech devices, including SIM cards and USBs. Recently, one dog found the phone of Samantha Murphy near a dam at Ballarat.[7]

For readers of yesterday's *Australian Financial Review* in hard copy, pages 11 and 12 had three articles on AI, one of which had the headline: "Artificial intelligence: Final nail in the coffin for the creative sector."[8]

I'm going to finish my shopping list here, and warmly welcome tonight's speaker, Julie Inman Grant. Following two decades working in senior public policy and safety roles in the tech industry at Microsoft, Twitter (now X), and Adobe, Julie was appointed in 2015 as Australia's eSafety Commissioner, a pioneering role leading the world's first government regulatory agency committed to keeping its citizens safer online.[9]

She was recently named one of Australia's most influential women by the *Australian Financial Review* and a leading Australian in foreign affairs by the *Sydney Morning Herald*. Earlier this year, she had the distinction of being named the "Australian censorship commissar"[10] — we quite liked that especially, because guess who called her that? Elon Musk, highlighting the irritation that some tech giants experience when governments seek to regulate content to protect the safety of their citizens.[11]

Julie, we are honoured to have you here. We look forward to hearing about your work in that world that the World Wide Web weaved.

Julie Inman Grant

Thank you very much, Your Excellency. It's wonderful to be with you here tonight. I would also like to pay my respects to the Gadigal people of the Eora nation and pay my respects to their Elders, past, present, and emerging. First, let me begin by thanking Her Excellency, The Honourable Margaret Beazley, Governor of New South

7 https://ia.acs.org.au/article/2024/australias-technology-detection-dogs-revolutionise-policing.html

8 https://www.afr.com/companies/media-and-marketing/ai-final-nail-in-coffin-of-australia-s-creative-sector-20240716-p5ju1u [Ed.]

9 https://www.esafety.gov.au/about-us/who-we-are/about-the-commissioner

10 https://www.bbc.com/news/world-australia-68878967 and https://www.internationalaffairs.org.au/australianoutlook/the-australian-esafety-commissioner-vs-x-testing-the-effectiveness-of-enforcement-powers-on-platforms/

11 See (Ritchie 2024) for Elon Musk's behaviour towards the author. "Doxxing" is maliciously releasing a dossier of personal information of another. Brady J (2013), What is doxing? *Tech News*, April 2. [Ed.]

Wales, the Royal Society of New South Wales, and Susan Pond for inviting me to speak to you tonight. It's a great honour, not least because the calibre of the speakers who have stood here before me, an impressive crowd — accomplished Australians of all walks of life from politics, academia, science, and the arts. I'm humbled to join such an incredible group of people, and I look forward to our conversation further tonight.

How a single letter changed the world

This evening's theme was put to me by the Governor: "How a single letter changed the world."

When I first turned my mind to this intriguing idea, I must admit, I wasn't entirely sure whether it should be a letter of the alphabet I should be singling out, or a world-changing message, whether written by hand, keyboard, voice recognition or even AI. So tonight, I've decided to hedge my bets a little and highlight a pivotal example of each.

WWW

I'll start with my chosen letter of the alphabet, W. It represents one of the most important, world-changing inventions in human history — and, no, it's not the wheel. Well, actually I'm cheating a little here but, repeated three times, W becomes that famous acronym for the World Wide Web, a development which changed everything irrevocably. And it continues to exercise its transformative influence to this day, endlessly reinventing the way we live, work, play, learn and communicate.

This would be enough in its own right but I feel I can't talk about the Web without at least acknowledging another important letter, in this case an open one, dispatched, appropriately by email. While not as instantly transformative as the World Wide Web itself, this late-night missive generated quite some discussion and debate at the time, and it influenced the early philosophical underpinnings of internet governance, principles tech companies still hold onto doggedly to this day.

Before I delve further into that, however, I need to provide a little more context. There is no disputing that the World Wide Web of today is a truly remarkable thing which pervades almost every aspect of our lives, so much so that I think every one of us here would struggle to imagine our modern lives without it. But while it seems indispensable today, it really wasn't all that long ago that the internet was in its infancy and the world was still very much in an analogue state.

While computers have been networked in one form or another since the 1960s, it wasn't until the 1990s when affordable personal computers met the 56k modem that the internet really took off. These game-changing devices finally brought the internet to the masses, allowing people to slip on a pair of digital boardshorts and really start surfing the web.

While it was a time of great promise, many also felt over-regulation of this burgeoning industry would be an impediment to innovation and growth. Tech companies were "moving fast and breaking things" and wanted only one thing from governments — *to stay out of their way*. For the most part, governments around the world were happy to oblige.

I know this time well, having worked at tech policy "ground zero" in '96, as a young lobbyist in another significant W: Washington DC. Of course, being the '90s, I had big ideals, big shoulder pads, and even bigger

hair, and eventually found myself working for an unassuming guy named Bill at a little software company called Microsoft.

It was Microsoft, AOL, AltaVista, Novell and Netscape that were the big end of town in the tech world at the time and — looking to the future through our rosy, techno-utopian glasses — we only had eyes for the *promise* this new online revolution would bring. Of course, this was Web 1.0 and social media wasn't really a thing yet — in fact, Mark Zuckerberg was just 12 years old and probably more concerned with building his latest Dungeons & Dragons adventure than the world's largest social network.

But with rapid advances in technology and computing power just around the corner, the internet we were preparing for all those years ago, would quickly outpace all of our imaginations.

John Perry Barlow writes a letter

Around the same time as I was walking the halls of the US Capitol, that other important letter I mentioned earlier was being written on a laptop at a raucous party in Davos in Switzerland during the 1996 World Economic Forum. This open letter was the now famous *Declaration of Independence of Cyberspace* penned by American poet, cyberlibertarian and occasional songwriter for cult US rock band "The Grateful Dead," John Perry Barlow.[12] In it, Barlow described a bold new vision of a completely free and open internet where people could reinvent themselves in this new virtual world with no government controls and no national boundaries. In short, governments should have no place in cyberspace.

While a revolutionary and somewhat controversial theory at the time, it was also an unashamed ode to a cyber utopia, focusing on the great promise this new world held for humanity, while giving little thought to how it might be potentially be misused to harm others, save for this one line. It said: *Where there are real conflicts, where there are wrongs, we will identify them and address them by our means.*

Now, I find this line compelling because I think it both mirrored and undoubtedly influenced how many of the tech leaders were approaching these issues in Washington DC at the time. Like Barlow, the industry I was then a part of also wanted the government out of cyberspace and pledged that if anything were to go wrong, they too would manage and moderate things themselves. Section 230 of the United States Communications Decency Act of 1996 helped enable and codify this, providing the industry, "intermediary immunity" from any bad acts or malicious content created by their users.[13]

Looking back, it was probably a little naïve of Barlow and the politicians in Washington to believe that such a new and untested industry could be left to its own devices and be trusted to self-regulate. But even then, the compelling industry arguments that regulation would put the brakes on innovation, economic growth and US tech hegemony were hard to resist.

Needless to say, Barlow's late-night email was one of the earliest examples of viral online manifesto and is still widely shared today. I was lucky enough to have the opportunity to have a spirited debate

12 https://en.wikisource.org/wiki/A_Declaration_of_the_Independence_of_Cyberspace

13 See https://www.pbs.org/newshour/politics/what-you-should-know-about-section-230-the-rule-that-shaped-todays-internet for a 2023 discussion of this section. See also Smith and Van Alstyne (2021) [Ed.]

around these concepts with Barlow at an expat Thanksgiving dinner party in London in 1997. But that is a story for another evening, in less polite company!

But this brings me to another triple-W representing one of the key questions being asked about today's online world: *what … went … wrong?*

What went wrong?

The views Barlow expressed in his declaration are emblematic of much of the public discourse we've been having around the internet for decades and continue to have today. Time and time again, governments have let their eagerness to reap the promised benefits of shiny new technologies blind them to any of the potential pitfalls and we are still yet to totally reconcile this today. Whether it's launching a new search engine to bring information to the masses, a social media platform to give a voice to those who previously had none, or disrupting an established industry to deliver better value and choice to the consumer, it is more often than not born out of a sincere belief that whatever the creation might be, it will make society better.

But I think today one could equally argue that many of these benefits have also come at a great cost, not just to individuals, but to society more generally, especially when the race to be first to deliver the latest product to market continues to outweigh the responsibility to ensure it is safe. The current industry scramble to be first to bring Artificial Intelligence to the masses is just the latest example of this flawed tech ethos. If we don't learn from our past mistakes and put in the safety guard rails now, I fear the damage that could be wrought on society by these immensely powerful programs could be irreversible.

To that end, I do think that 2023 reached a tipping point when generative AI came so quickly into the mainstream. Governments finally took notice of not only the long-term existential threat to humanity promised by the arrival of Artificial General Intelligence, or AGI, but of the immediate online harms we are already starting to see play out today.

2023 was also the year governments coalesced around AI Safety — and a year when many other countries joined Australia by passing key online safety legislation and setting up independent online safety regulators — specifically in the UK, Ireland, and across the European Union through the Digital Services Act.[14]

eSafety also set up and chaired the Global Online Safety Regulators Network,[15] a formal body that would help ensure cross-border collaboration and information sharing in online safety regulation. After all, the Internet is global, whilst laws are local, and the only way we are going to encourage a very entrenched and powerful industry to start minimising harms at-scale, is by working together. And the only way we are going to create a safer, more civil online world is to ensure that the fundamental building blocks are "safer by design."

In some ways, the internet serves as a mirror reflecting societal ills, but there's no doubt it can serve to amplify and even weaponise them.

14 https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package

15 https://www.esafety.gov.au/about-us/who-we-are/international-engagement/the-global-online-safety-regulators-network

The age of digital divisiveness

In this age of unbridled digital connection, modern society has probably never been more polarised than it is today, with public discourse and respectful debate replaced by increased intolerance and division, as algorithmic echo chambers reinforce and often provide false legitimacy to more and more extreme views. We are truly entering the age of "digital divisiveness."

Sadly, much of this outrage-driven engagement has been the "by-design" guiding principle, to keep platforms sticky; and with business models driven by paid influencers, surveillance advertising and subscriptions, those who are most outspoken or controversial profit the most. As a result, democratic ideals and institutions have never been under such grave threat. The January 6th riots at the US Capitol building after Donald Trump's election defeat in 2020 gave us a terrifying glimpse of the power and influence the internet holds over us all and just how fragile and delicate the fabric holding democracy and society together can be.[16]

In some ways, January 6th should not have been a surprise. During his presidency, Donald Trump not only savagely abused foes online with impunity but was identified as a major "superspreader" of mis- and disinformation. However, his online audience was so sizeable and his content went so viral, that none of the major platforms suspended him for repeated policy violations, making excuses for vaguely worded "exceptions" for public figures.

A 2021 analysis of 120,000 posts and tweets on Facebook and Twitter (now X) found that there was just a small collection of 12 individuals and their organisations responsible for the vast majority of anti-vaxx misinformation circulating on the global Internet during lockdown.[17] Whilst Donald Trump could not claim the dubious distinction of being named one of the "Disinformation Dozen," another US presidential candidate, Robert Kennedy Jr., *is* amongst them. Again, Instagram, Facebook and Twitter failed to enforce persistent violations of their own house rules until the incitement of online violence so clearly spilled into real world harm that they *had* to act.

Even this past weekend, where we saw political leaders of all stripes condemning the political violence brought so clearly into focus by the attempted assassination of Donald Trump, the unhinged fringe and conspiracy theorists spun mistruths more quickly than the government and journalists could uncover and report the facts. This came from both the Left and the Right. And the hashtags "Civil War" and "Fake Assassination" trended across social media in a matter of moments. And so, even though today we are blessed with instant access to almost limitless information at our fingertips, we've never been more distrustful of it. Indeed, the online world is starting to resemble an ever-expanding desert of misinformation with fewer oases of truth in which we can find refuge.

Unfortunately, humans are going to have their critical reasoning skills even more challenged with the accessibility, ease of use and

16 The riots across the UK after the killings in Southport, with Elon Musk's encouragement, are a further example of the power of misinformation on social media to create mayhem in mature societies. See https://www.bbc.com/news/articles/cd1e8d7llg90 [Ed.]

17 https://counterhate.com/wp-content/uploads/2022/05/210324-The-Disinformation-Dozen.pdf

low cost of powerful AI applications that allow anyone with a smartphone to create photo-realistic deepfakes of people saying and doing things they didn't really say or do. Deepfakes have now become "cheap-fakes" that are easy to create and difficult to discern by even the trained eye. They cost virtually nothing for the perpetrator to make but exact a devastating, lingering and incalculable cost to the victim-survivors.

Without content provenance requirements and an acceleration of accurate and rapid deepfake detection tools, there is a real risk that a deepfake could become the viral narrative before the real truth is revealed. Like many have said before, unbridled AI could not only upend free and fair elections and continue tearing at the fabric of society but it could also ruin lives.

Bullying

The Web, and the technology that underpins it, has enabled new kinds of abuse that didn't exist before its creation. While children have always faced the threat of bullying, today's internet has made it so much more pervasive and invasive, heightening its impact on a child. Where once a child would find respite when they walked out of those school gates, thanks to smart phones, social media and messaging apps, bullying now follows children 24/7 into their homes and bedrooms.

eSafety administers the only youth cyberbullying complaints scheme in the world and we have a 90% success rate in getting this harmful content taken down when the platforms fail to act. But we continue to witness concerning trends. In the year to May 2024, complaints to us about cyberbullying of children were 311% higher than the same period four years ago. Most of this continues to be peer-to-peer but we're also seeing children as young as nine years old reporting to us. This is part of a larger trend post-lockdown where parents were much more permissive with children and their technology use.

Complaints about image-based abuse — or the non-consensual sharing of intimate images — were 242% higher, driven primarily by sexual extortion reports. As a result of this trend, the demographics of intimate-imagery abuse have markedly changed. At the inception of our image-based abuse scheme in 2018, 70% of image-based abuse targeted women and girls — often as a consequence of relationship retribution.

Today, overseas criminal organisations are targeting young men between the ages of 16 and 24 for large sums of money once they have tricked or coerced them into creating and sharing sexual imagery of themselves. In some very tragic cases, these young victims have taken their own lives rather than face the shame of seeking help from friends or family. Meanwhile, other forms of image-based abuse, including abuse related to family and domestic violence issues such as coercive control and the incidence of "deepfake image-based abuse" have also surged.

Reports of illegal and restricted content were 111% higher. We investigated some 33,000 URLs over that 12-month period, 85% of which concerned suspected child sexual abuse material. Last year, we also reported that one in eight complaints about this material now relate to self-produced child sexual abuse coerced remotely by a predator online, and often captured in the child's bedroom or bathroom of the family home — literally under their parents' noses.

Add to this overlay of clearly definable harms that eSafety is seeking to tackle with

tools under the Online Safety Act,[18] the next generation of harms we have not fully reckoned with are already on their way. Whether it's the prospect of "augmented telepathy" or the robbing of "cognitive liberty" through invasive technologies like neural implants, we need to start preparing now.

Age restrictions on internet users

To be sure, the latest wave of techno-panic being exported from the US is already washing over our shores warning us that screen time is re-wiring kids' brains and social media is the sole cause of teens' anxiety and depression. This was given more heft when the US Surgeon General recently suggested public health warnings should be applied to social media, much like those emblazoned on cigarette packets to warn of the potential health risks posed.[19]

Some argue the tech industry is already acting like Big Tobacco and should therefore be treated as such, as the industry is accused of ignoring compelling research that shows the damage its platforms pose to children so tech firms can protect their bottom lines. This debate might even see Australia swinging the pendulum much more into the interventionist camp of online safety regulation, with a media-fuelled push banning children under the age of 16 from joining social media.

While this will ultimately be a policy question for Government,[20] I think a much deeper debate needs to be had around what we mean by social media — because kids aren't posting to Facebook like they were a decade ago, but are using a range of different platforms and instant messaging services. We also need to think long and hard about what the unintended consequences might be of pushing kids into darker recesses of the Internet. I'm also concerned the pursuit of forbidden online fruit will deter help-seeking and confiding in parents when things do go wrong online.

I can tell you that the evidence base is thin and the research very mixed on all of these questions. But the teens who are the most marginalised and vulnerable today are the most likely to be impacted by such a ban. Our research clearly shows that LGBTIQ+ teens, First Nations youth, and those with a disability feel more comfortable and themselves online than they do in the real world and depend on technology to connect, explore and find their tribe.

To be honest, as Australia's regulator in this area, I'm struggling to get my head around the "how" in terms of successfully implementing such a policy. You see, I have been working on age assurance in one shape or form since 2008. In 2023, eSafety delivered an age-verification roadmap to government. A trial is now underway and I've also given industry six months to create meaningful codes to prevent children from accessing pornography and other high-impact content up and down the tech stack: on devices, through app stores, in search engines, and on social media. But until these fundamental age-assurance technologies and associated safeguards are in place,

18 https://www.legislation.gov.au/C2021A00076/latest/text

19 https://www.theguardian.com/us-news/article/2024/jun/17/surgeon-general-warning-social-media

20 The Australian government plans to ban under-16s from social media platforms. Nov 6, 2024. https://www.abc.net.au/news/2024-11-08/how-the-age-minimum-for-social-media-will-work/104571790 [Ed.]

implementation and enforcement of such a ban will be virtually impossible.[21]

Or water safety awareness

The best analogy I can give to you in terms of a recommended approach starts with another W: water safety awareness. Australia has built and excelled in water safety over the past several decades, often in response to tragic circumstances — and this has important lessons for successful approaches towards online safety. In short, we fence pools and we back these rules with enforcement; but we do not try to fence the entire ocean. On our beautiful beaches, we protect our citizens from a young age teaching them to swim, to stay between the flags and recognise rips to avoid danger. We also put in shark nets to protect from predators that might be lurking just beneath the water. But no matter how well we prepare our kids, we still keep a close eye on them in the water because we well understand the dangers.

We should be using the same philosophy online. We need to ensure our kids have the confidence and digital literacy they need to navigate the online currents safely, while teaching them how to spot the dangerous algorithmic rips and lurking predators. Parents should act as the digital lifeguards, keeping a close eye on our kids while still allowing them to dip their toes in the ocean. And our extensive parent content on https://www.esafety.gov.au/[22] helps empower parents to do just that!

The world's first online safety regulator

This now leads us to *why* eSafety was stood up as the world's first online safety regulator in 2015 and how we approach this work. As you can imagine, there was no playbook available for online safety regulation, so we've had to fill in the pages as we've gone along. In some cases, we've had to write the playbook.

Prevention

Our approach and model is multi-pronged beginning with *Prevention*. Through our research, education, and awareness-raising programs, we strive to prevent online harms from happening in the first place. These start in the early years, as 91% of kids have access to a digital device by the age of 4, all the way to over-65s through our Be Connected program.[23] But meaningful and lasting societal change takes time and until then, Australians suffering harm will continue to reach out to us for help.

Protection

This is where our *Protective* powers come in. Under Australia's Online Safety Act, eSafety operates several world-first schemes to protect Australians online. I touched on these issues earlier but these include our child cyberbullying scheme, our serious adult cyber-abuse scheme, and our image-based abuse scheme. Through these complaints-based regulatory schemes, we support individuals in the grip of personal online crises by compelling social media platforms and websites to take down abusive and

21 Australian parliamentary inquiry stops short of backing social media ban for under-16s; see https://www.aph.gov.au/Parliamentary_Business/Tabled_Documents/8267 [Ed.]

22 https://www.esafety.gov.au/parents

23 https://beconnected.esafety.gov.au

harmful content. We also have remedial powers that target both perpetrators and platforms. In my estimation, this is one of the most unique and important functions we have — we serve as a safety net and can remediate harm quickly when the platforms fail to act.

Proactive and systemic change

Our daily engagement with Australians gives us insights into concerning online trends and also provides us ample evidence of where the companies are failing at a systems and process level. I'll touch on our systemic powers around transparency, codes and standards in a bit, but I wanted to touch upon our third pillar, "*Proactive and systemic change*," which is not enshrined in our legislation but is critical to being an anticipatory regulator and in shifting the burden of safety back onto the platforms themselves.

Safety by Design

Key to this is the Safety by Design initiative[24] eSafety launched in 2018, something we did *with* rather than *to* the industry. We have to be realistic that we will never arrest or regulate our way out of online harms, so we thought it reasonable for companies to assess risks upfront, understand how the harms manifest against their users, and incorporate safety into every aspect of how they design, develop, and deploy their products and services.

Victoria's 1970 seat-belt legislation

The best way to explain this approach, I have found, is through real-world analogies. I'm going to take you back even further — more than a half century — to remind you of a young American lawyer named Ralph Nader, who began publicly questioning car makers' accountability for traffic fatalities; critically examining the intersection between vehicle design and a lack of embedded safety features like the humble seatbelt. His ideas culminated in a book called *Unsafe at Any Speed* — and this led to a new era of automobile regulation, still guided today by international standards.

Predictably, at the time, the auto industry vehemently pushed back. They didn't want to invest in seatbelts or any other safety features, believing the ongoing costs would be prohibitive and would stifle both profits and automotive innovation. Of course, today we know the seatbelt alone has saved millions of lives and we take for granted that every car is now brimming with life-saving technologies that are built in — like airbags and anti-lock brakes. In fact, today, car manufacturers differentiate themselves in the marketplace based on their safety ratings and consumers take note. Proof that safety sells!

Yet, despite the appeal to consumers and to serious harms reduction, it took legislative bodies around the world to compel the embedding of seatbelts into cars for these to become standard fare.[25] There are certainly a number of comparisons we can draw here

24 https://www.esafety.gov.au/industry/safety-by-design

25 From December 22, 1970, the state of Victoria became the first jurisdiction in the world to make wearing of seatbelts mandatory while travelling in a car. Front seatbelts had been mandatory in all cars sold in Australia since January 1, 1969. https://www.carsales.com.au/editorial/details/buckled-to-history-21137/ [Ed.]

with the current state of technology regulation.

I believe we are fast approaching the tech industry's "seatbelt moment" — and not a moment too soon, as a new industry race has begun to bring AI to the masses and to be the first to colonise the "metaverse." But history shows us that it's unlikely companies will make this important transition to safety-first technology voluntarily — shiny new gadgets that please consumers and securing first-mover market share is pleasing to shareholders, so will almost always win out. We also see piecemeal retrofitting of safety features announced by press release — with no data from platforms on take-up or efficacy.

The simple truth of the matter is, if your platform has 50 different parental controls that parents have to toggle on, then you haven't used safety by design as a fundamental development principle. Likely the only way you are going to make your service truly safe is by totally re-engineering it.

Australia's Online Safety Act (2021)

For this reason, Australia's Online Safety Act (2021) includes important systemic powers aimed at applying significant pressure on the industry to bring about meaningful change — and that involves looking under the hood.

The first of these powers is Basic Online Safety Expectations,[26] which includes wide-ranging transparency powers that compel companies to answer key questions about how they are living up to these expectations and tackling a range of online harms. Under these powers, we've sent 19 notices covering 30 major services including Apple, Google, Meta, Microsoft, TikTok and X Corp, asking questions about how they are tackling a range of harms, including child sexual abuse, terror and violent extremism, sexual extortion, online hate, and harmful algorithms.[27]

Just getting these companies to finally lift the lid and reveal some of their inner workings is a *win* in itself. For decades governments around the world have been asking these same questions with little success. We are now sharing this data with our international partners to help them better understand what *is* and *is not* being done. It continues to be my belief that sunlight acts as the best disinfectant.

Through the operation of these powers, we've seen positive online safety outcomes. Unsurprisingly, some of these changes have come about through the "naming and shaming" aspect of these powers — as it is generally reputation and revenue impacts that are more likely to move companies toward the light, rather than regulation alone.

We understand that this will be a constant battle. Just as governments are achieving greater levels of transparency about what is actually happening within the metaphorical bowels of these platforms, we are, in fact, seeing movement from the major industry players to become more opaque.

Placing Application Programming Interfaces (APIs) out of reach, threatening litigation, personally targeting regulators and justices, acquiring and then deprecating potent social media monitoring tools like

26 https://www.esafety.gov.au/industry/basic-online-safety-expectations [Ed.]

27 See Root and Ashford (2024) [Ed.]

CrowdTangle[28] are just the opening gambits. Governments need to continue pushing harder and staying a step ahead.

Another way we are trying to get and stay ahead and encourage active systemic change is through the implementation of mandatory codes and standards to tackle online child sexual exploitation and pro-terror material.

As an example of another very significant win, six world-first codes are now in operation across eight sectors of the technology ecosystem. While two of these codes produced by industry did not meet appropriate safety community safeguards required under the Act, I was able to use my powers to write the rules for them moving to industry standards. These two standards cover broad groupings of tech services like cloud-based file and photo-storage services, gaming and dating sites, and messaging services.

I cannot impress upon you how pivotal these two standards are in protecting children, as we know that cloud-based storage services and encrypted messaging are used widely by paedophiles and terrorists to store and distribute this incredibly damaging content. The standards have been registered with the Parliament and — following the usual due process — should also come into force around Christmas.

But, of course, the more things change, the more they stay the same, and dogged industry resistance to any regulation remains an ongoing challenge. For years we've seen some big tech businesses throwing their weight around Down Under, challenging Australia's approach on important issues like harmful online content, child protection and even payment for news.

The stark headlines are nothing new, nor are they unique to our shores and we should not be swayed by them. For example, some high-profile industry members affected by our standards were so worried about the global implications of what we were asking them to do that they mounted what can only be described as a good old-fashioned fear campaign to sow public and policymaker doubt.

While solely focused on forcing the industry to do more to prevent their services being misused by paedophiles to harm children, one leading company (named after a fruit) even went so far as describing eSafety's draft standards as a "Dystopian Dragnet" which would inevitably lead us down a slippery slope of mass government surveillance of ordinary, law-abiding citizens.[29]

The pushback from encrypted services was just as fierce, despite eSafety being explicit that we do not expect industry to break or weaken end-to-end encryption. But we were equally explicit that it was no longer good enough for encrypted services to throw their collective hands in the air and do nothing either. This is a form of wilful blindness and serves as another example of the industry once again prioritising the absolute privacy of adults to undertake any act "in the dark" without considering the dignity and commensurate rights of children to live free from online violence and abuse.

We can and will weather the pushback from one of the most wealthy, stealthy and powerful industries in modern history — what other choice do we have but

28 Meta's CrowdTangle was no longer available after August 14, 2024. [Ed.]

29 Apple warns that scanning encrypted photos leads to a "dystopian dragnet," *The Stack*, Sept. 4, 2023. https://www.thestack.technology/apple-photo-scanning-csam-dystopian-dragnet/ [Ed.]

to continue standing up and pushing the regulatory barrow against this long-term "technological exceptionalism"?

After the Bondi Junction stabbings

Part of the job of a regulator is to test the efficacy of the powers we have today. Those powers were certainly put to their first real public test in April 2024. You may recall in the wake of the Bondi Junction tragedy there was a graphic high-impact video of an attempted murder of a bishop delivering a livestreamed sermon at his church in Wakeley. The attack was declared a terrorist incident by the NSW Police Commissioner, committed by an allegedly radicalised teenager: more than 52,000 potential terrorist and violent content images were later found on his phone.

No surprises there that exposure to harmful terrorist content will desensitise, normalise and even radicalise impressionable young minds.

Following the Christchurch atrocity of 2019,[30] the Government proscribed a very specific role for eSafety when a potential livestreamed attack like this occurs. We conduct rapid-fire, online investigations to determine how far and how quickly this high-impact and gratuitous violence is spreading to determine whether it should be deemed an "online crisis event." We then notify the social media companies of the content and assess what steps they are taking to stem its viral spread and protect innocent eyes from stumbling across something they would never be able to unsee. Our sole goal and focus is to prevent extremely violent content from going viral, and in the case of the Wakeley attack, potentially inciting further violence and inflicting more harm on the Australian community.

And so, on 16 April, eSafety issued formal removal notices to Meta and X Corp — requiring both companies to take all reasonable steps to ensure the removal of this extreme violent video content. The removal notice identified specific URLs where the video material was located on both of these services.

Their responses could not have been more different. Meta complied within the hour, following up consistently with updates on the steps they were taking to ensure this abhorrent content was not re-loaded and re-shared.

But as we all saw, X Corp not only refused to remove the content but vigorously defended their right to keep hosting the video of a brutal attempted murder on its platform in the Federal Court, despite the fact that the video more than likely violated their own terms of service.

And this brings me to one of the most disappointing Ws of them all.

Weaponisation

While many companies acknowledge their societal responsibilities in a moment like this, some companies choose *Weaponisation* of their platforms for profit and *warfare* with regulators, or more accurately "all out lawfare" against those who try to bring more safety and civility to their platforms, rather than set any global precedent that compliance might create.

X Corp is sadly such a company and in this case, its barristers deftly avoided addressing the harmful nature of the content, rather directing focus instead on the more abstract

30 Dobbins (2019) [Ed.]

concepts like the comity of nations; freedom of speech under the US First Amendment; and even whether a decision might subject the Federal Court to international ridicule. As a result, we saw very clearly that this was a particular legal battle we were not going to win, so I chose a strategic withdrawal so that my powers could be tested before the Administrative Appeals Tribunal (AAT). Fear not, the legal battles with X remain ongoing …

We are involved in five more separate actions with X Corp, either in the Federal Court or the AAT, including a key Federal Court battle around X Corp's non-compliance with a transparency notice asking questions about what the company is doing to combat child sexual abuse material and failure to pay the infringement notice.

But herein lies the rub. These companies have almost unlimited funds to tie regulators up in multiple, lengthy and costly litigations. It's a strategy I like to call "death by a thousand courts" and one they have repeated in other parts of the world. In fact, Elon Musk just threatened to take the European Commission to a "very public battle in court" for preliminary findings that X Corp violated the Digital Services Act for a range of deceptive design features.

But this process has unearthed a bigger, more fundamental question which all tech regulators and countries outside the US will need to grapple with: if technology companies like X Corp are not answerable to the laws of the sovereign nations in which they operate and extract revenue, then to whom are they ultimately answerable?

An answer to this pivotal question is well beyond the boundaries of one litigation or the jurisdiction of a single court and will have sweeping implications for all digital platform regulators. We need to ensure these decisions are made in the right forum with a broad range of decision makers.

A way forward?

So, how do we find a *way* forward? One thing that's clear is that the ability of all sovereign nations to protect their citizens from harmful online content and conduct needs to be part of a global conversation. Perhaps it is a convention, or a treaty, or the equivalent of a "Bretton Woods"[31] for cross-jurisdictional regulation of online harms.

As mentioned, eSafety has aligned with other global safety regulators through a formal organisation and recently signed a regulatory MOU with the European Commission, a formidable bloc with plenty of regulatory heft behind them.[32]

But of course, the issue of regulation and sovereignty will likely continue to be challenging until the most significant jurisdiction where most global tech giants are headquartered — the United States — makes serious attempts to pass safety legislation and hold them accountable.

Things did seem to be moving in a positive trajectory with an emotionally-charged US Senate Judiciary Committee hearing in January 2024, but further progress has stalled. Of course, the outcomes of the upcoming US election can and will have reverberations for technology regulation, regardless of the outcome. How can it not?

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31 The 1944 Bretton Woods Conference led to the regulation of the international monetary and financial order after the conclusion of World War II. [Ed.]

32 https://www.esafety.gov.au/newsroom/media-releases/esafety-partners-with-the-european-commission-to-support-enforcement-of-online-safety-regulations

But, importantly, while these court battles have been going on, the Australian Government has also brought forward the Online Safety Act Review[33] and I have no doubt the recent experience with X Corp. and any weaknesses exposed in our legislation during this case will be examined closely to ensure future legislation is fit for purpose. Some options on the table for consideration include bringing our powers into line with those of the UK and European Union, with powers to fine companies up to 10% of annual operating revenue as well as significant business disruption powers.

In any meaningful plan to find a way forward, I think it's hugely important there is a greater degree of coherence and coordination between global regulators. While our regulatory systems will never be identical, it's important they are aligned to increase our collective effectiveness in regulating these powerful, US-domiciled companies.

I know that was a lot and I want to thank you so much for listening.

Recently, 2021 Nobel Peace Prize winner Maria Ressa[34] labelled today's tech CEOs as the "world's largest dictators." Maria is someone whom I deeply respect — and has tangled with political dictators throughout her journalistic career — so certainly knows tyranny when she sees it. But I think she makes a valuable point about a seemingly untouchable class of powerful and politically potent tech billionaires and their followers.

When you really think about it, today's tech leaders wield almost unlimited power, not just over a single country, but over a captive global populace. They also don't just hold themselves above the law but seem to exist completely beyond it, backed by almost inexhaustible financial resources.

Up until his death in 2018, Barlow steadfastly stood by his Declaration of Independence of Cyberspace, but I do wonder, if he was still alive today, and witnessed so much power and influence in the hands of so few in his cherished egalitarian cyberspace, whether he would start to have some second thoughts.[35]

The World Wide Web has undoubtedly changed the world, but we can't just continue to celebrate the good while turning our backs and ignoring the bad. This is a world we wove — or rather, a web spawned in the great US of A — and there haven't been meaningful guardrails to prevent these harms.

Think of how far the online world has come in the past 30 years from the dial-up days, and yet Section 230 of the Communications Decency Act has not been touched since 1996.[36] But there is hope. I believe we are making quiet but solid progress and — with more countries and jurisdictions creating their own online safety regulators coming online — we are no longer alone in this fight. eSafety was once the sole voice in the wild calling for change — we are now hearing these calls from others around the world echoing like a steady drumbeat. Safety by Design is taking hold globally; governments are asking global tech companies to

33 https://www.infrastructure.gov.au/sites/default/files/documents/online-safety-act-2021-review-issues-paper-26-april-2024.pdf [Ed.]

34 https://www.sipa.columbia.edu/news/nobel-laureate-maria-ressa-join-sipa-faculty [Ed.]

35 See https://en.wikipedia.org/wiki/John_Perry_Barlow [Ed.]

36 See Solomon (2024) for recent cases, research, and actions in the US. [Ed.]

prioritise safety and well-being ahead of tech profits and shiny new gadgets.

Can we do it?

And this brings me to the final and most important W of all — *we*. It really is only by working together, and showing regulatory courage and cooperation across borders and jurisdictions that we can hope to change how the technology game is being played.

Ever the optimist, I remain eternally hopeful that, if we do this, we can wrest back control of this incredible world-changing invention and have the safer and more inclusive world wide web we all want, in line with what its creators always envisaged. Thank you.

Questions and Answers

Susan Pond: Thank you, Julie. Thank you very much. That was incredible. I don't know where the 45 or 50 minutes went, but they've flown by. I only saw a few people's heads bobbing. My name is Susan Pond, and I'm honoured to be the President of the Royal Society of NSW. In partnership with Her Excellency in Government House, we have held *Ideas@theHouse* ten times now, and it hasn't disappointed. We've had amazing presentations, and yours is right up there in the pantheon. I'm going to open it up to the audience.

Q1: Thank you, Julie, for that absolutely fantastic presentation. I'd like to thank you very much for the work you and your part of the government do to protect our children. I was very interested in your analogy with the car industry. Having worked for a large company for 27 years myself, I saw the internet go from a nice utopian place to one with a very dark side. When cars were introduced, the government imposed safety measures by insisting manufacturers install seat belts. Is there something similar we could do for the internet? We all access it through physical devices. Could we ask manufacturers to install safeguards, akin to installing seat belts? I know it's not a perfect solution, and there would be challenges, but I'm wondering if there are ways we can use our sovereign power to build in some solutions to address this problem?

JIG: Well, the codes I mentioned actually divide the technology industry into eight different sectors, and phase one of the codes took almost three years to develop. That's why I gave the industry six months. We put together a paper for them, basically saying we need choke points and safeguards throughout the stack on devices, through app stores, and search engines. That's one way. With the Online Safety Act review, I suspect there will be an approach around a duty of care, with Safety by Design being a fundamental element of that. You're absolutely right: when we import Tesla cars to this country, we expect them to meet Australian standards. Otherwise, they don't come in. But this technological exceptionalism and jurisdictional arbitrage we're seeing will continue to challenge us. Have you seen Andrew Forrest's litigation against Meta for scams? He's taking it to California to meet them where they are. One technicality in the judicial review that X Corp is challenging us on involves Nevada incorporation law and whether it carries duties for foreign jurisdictions. A lot of people in government thought the jurisdiction question was answered, but I don't think it has been.

Q2: Thank you for your presentation. We really admire and respect the work you do for us. We can't deny that the rapid rise of technological advancements comes with many benefits, but, as you mentioned, there's also misuse of technology. How do you think young people can help create a safer online environment?

JIG: I think role-modelling good digital behaviour is the first step. I want to mention that key members of my staff are here, and I'm just one person; I couldn't do it without them. One of my special guests here is Professor Joanna Weaver, who developed the Technology Policy Design Centre. People often ask if I always wanted to be the eSafety Commissioner. I didn't; there was no internet, and I had no idea I would be living in Australia. But I think you make your own luck, and I've been lucky to be in the right place at the right time, just when technology policy was happening in Washington DC. Before there was an internet, I was working for my hometown Congressman on social issues. One day, he said, "We've got this small company in our electorate called Microsoft. Can you work on technology issues too?" So, I started working at the intersection of social justice, policy, and technology before there was an internet. That was lucky, and then I created a path to pursue an interest. Many people are turned off by technology, but technology policy is for those of us who are right-brained and want to bring social justice to technology. Of course, legal degrees help as well.

SP: Your passion is infectious, and the work you're doing is extremely important. Thank you for sharing it with us tonight. We're all in a world where it's difficult to determine the difference between right and wrong in the metaverse — the tensions between transparency and censorship. We applaud you for the work you're doing. It's not easy, as you've demonstrated. We're all with you in the broader society as we see the struggles in our children and grandchildren and the attempts to regulate in a world where technology far outpaces policy. Can you tell me your greatest nightmare? Is it that the technology is outpacing policy and the gap is probably getting wider?

JIG: Actually, it isn't. My greatest nightmare is that someone will take their own life after they've come to us, whether due to cyberbullying or experiencing sexual extortion, and we couldn't help them.

SP: Yes, I'm sure you have many nightmares. Would you please join me in thanking Australia's eSafety Commissioner, Julie Inman Grant.

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Emerging threats from climate change on our oceans demand proactive action

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Abstract

World ocean ecosystems are increasingly disrupted by human activities. But converging stresses, amplified by global warming, remain largely unrecognised. Changes developing in the world ocean systems pose significant threats in the form of major economic and physical impacts on human populations of every continent.[2]

World oceans are vital to human health and survival

- As a carbon sink holding some 60 times more carbon than the atmosphere, absorbing some 30% of all human-caused CO_2 emissions, accounting for 97% of the planet's water, and absorbing around 90% of the excess planetary heat[3]
- As a food source, especially for the most disadvantaged populations; providing potential solutions to key problems on land, regulating risks from extreme weather events; and yielding a wide range of products including medicines, and potential plastic substitutes
- As an enabler of major economic activities, representing some $2.3 trillion per year in goods and services,[4] including transport of some 49% of all goods,[5] providing small-scale livelihoods to nearly 500 million people, and 11% of agricultural trade by value, as well as transport of people, tourism, and recreation.

The life-supporting capacities of the world's oceans are increasingly threatened by global warming

Sea-surface temperatures are already beyond the warning level of 1.1 degrees above pre-industrial levels and the rate of ocean warming appears to be increasing.

1 See the 31 names of the contributing co-authors below. This is the Consensus statement from the Regional Action on Climate Change Symposium (RACC-16) held on the 5th October 2024: An adjunct session of the Science Technology and Society Forum, Kyoto.

2 This paper is reprinted with permission from *Sustainability Science*, in press. It was published under a CC-BY license. It is also online at https://www.stsforum.org/racc2024/pdf/statement.pdf

3 IPCC (2019), Summary for Policymakers, *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner, et al. (eds.)]. Cambridge University Press, pp. 3–35. https://doi.org/10.1017/9781009157964.001

4 UNDP (2022), Ocean Promise, https://www.undp.org/sites/g/files/zskgke326/files/2022-06/UNDP_Ocean_Promise_V2.pdf, viewed 7 November 2024.

5 European Commission (2024), Maritime Transport, Blue Economy Observatory, https://blue-economy- observatory.ec.europa.eu/eu-blue-economy-sectors/maritime-transport_en, viewed 7 November 2024.

- The stored heat is unevenly distributed across the oceans, affecting sea levels, extreme events, ocean conditions and ecosystems
- Tropical storms — the leading cause of losses and damages in the tropics, and in particular cyclones, carrying additional energy — are intensifying in force and rapidity, reduced warning time[6]
- Increases in atmospheric carbon dioxide are raising ocean acidity, already 30% higher than pre-industrial levels, with increasingly severe implications for marine life and the rich ecosystems of coral reefs[7]
- Stress caused by acidification is compounded by record-breaking ocean temperatures — already creating widespread coral bleaching[8] and severely affecting all calcifying organisms
- The capacity of the oceans to absorb and retain carbon from the atmosphere is declining as oceans warm. Simultaneously, the warming water is expanding and, in conjunction with ice melt, is producing sea-level rise, threatening many key areas of infrastructure[9]
- Impacts from rapid changes to the oceans are compounding other stresses, namely, overexploitation of fish stocks, inflows of some 5–12 million tonnes of plastic each year, unknown and unmeasured impacts of inflows of synthetic pollutants, and rapidly growing nitrogen pollution, expected to double in the next few decades, contributing to increasing algal blooms, ocean hypoxia, global warming, coastal eutrophication, and severe impacts on human health[10]
- Accelerating interacting stresses, creating "cascading impacts on ecosystem structure and functioning"[11] involving a widening range of marine species, and long-term survival of major coral reef systems.[12]

The risks for human health and well-being and ecological sustainability of stressed oceans are serious and growing

- Increased storm intensity creates loss of life and property, whilst increasing ocean turbulence and nutrient richness results in more frequent massive algal blooms. These changes, coupled with rising sea surface temperatures, enhance abundance of marine and estuarine pathogenic microbes, such as cholera and non-cholera *Vibrio* spp., with increased occurrence of infections and outbreaks of disease

6 IPCC (2021), Summary for Policymakers, *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V. et al. (eds.)], B.2.

7 United Nations (2024) *The Sustainable Development Goals Report 2024*, Goal 14, Life below water, pp. 36–37.

8 Ibid.

9 IPCC (2019), Summary for Policymakers, op. cit., A.3.

10 UNDP (2022), Ocean Promise, op. cit.

11 IPCC (2019), Summary for Policymakers, op. cit., A.5.

12 Henley, B.J., et al. (2024), Highest ocean heat in four centuries places Great Barrier Reef in danger, *Nature* 632 (8024), 320–326, https://doi.org/10.1038/s41586-024-07672-x

- The impacts of climate change on the hydrologic cycle[13] are adding to impacts from sea-level rise. For example, in Asia and Africa, low-level delta regions playing critical roles in food security, biodiversity and economy, and home to more than 500 million people, face impacts of increased river flooding combined with flooding and salinisation from sea-level rise
- Melting of glaciers greatly sharpens these risks. For example, in Africa millions face consequential droughts and floods, with glaciers in Tanzania and Uganda predicted to be gone in the 2040s[14] and with warming in the Hindu Kush Himalayas, three times faster than the global average, threatening water for drinking, irrigation and energy for some 3.3 billion people across 11 countries.[15]

Knowledge of the oceans remains limited

Ocean sciences is a young discipline. Many of the interactions within the oceans, and between the oceans, land, atmosphere, ecosystems, and humans, and the relationship between ocean ecosystems and climate remain poorly understood. These include impacts of increased ocean acidification and effect of human actions on deep-ocean ecology notably when deep-sea-floor mining is being proposed and implemented. As an urgent first step, further ocean monitoring and modelling technologies need to be strategically developed and deployed.

Major human populations, both coastal and inland, are dependent on the oceans and particularly vulnerable to multiple impacts of the changes that are occurring

Examples include:

- Compounding risks of sea level rise on the 11% of the global population (896 million in 2020) living in cities at low elevation[16] and the projected possible 5.2 billion coastal population by 2080[17]
- Impacts on agriculture with saline ingression for sea-level rise, notably on crops in Asian mega deltas such as the Ganges and Mekong, and the African Nile and Niger
- Indirect impact from changes in marine biodiversity and coastal ecosystems, including re-location of species caused

13 Falk, J., et al (2024), Critical hydrologic impacts from climate change: addressing an urgent global need, *Sustainability Science*, 19, pp. 241-244, DOI: 10.1007/s11625-023-01428-8, and *Journal & Proceedings of the Royal Society of New South Wales* 156: 291–297, 2023.

14 Scown, M. W., et al. (2023), Global change scenarios in coastal river deltas and their sustainable development implications, *Global Environmental Change*. 82 p. 102736, https://doi.org/10.1016/j.gloenvcha.2023.102736

15 Wester, P., et al. (eds.) (2019), *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*, Springer Nature Switzerland AG, Cham. (eBook). https://doi.org/10.1007/978-3-319-92288-1x

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17 Mayewski, P. A. et al. (2020). Climate Change in the Hindu Kush Himalayas: Basis and Gaps. *One Earth*, 3(5), 551–555. https://doi.org/10.1016/j.oneear.2020.10.007; Shrestha, S., Bae, DH., Hok, P. et al. (2021), Future hydrology and hydrological extremes under climate change in Asian river basins. *Sci Rep* 11, 17089, https://doi.org/10.1038/s41598-021-96656-2

by global warming, threatening coastal fisheries[18]

- Disrupted food production in islands whose vulnerabilities include economic dependence on limited sectors, geographic isolation, and high-disaster risk. Those populations face increasing loss and damage, cultural upheaval, loss of food and land from sea-level rise, coastal erosion, and storm surge
- Rapidly declining yields of fisheries, creating economic and social impact on coastal communities at "the frontline" of the "triple exposure:" climate change; blue economy growth; and poorly planned area-based conservation. Rapid declines in ocean fish stocks threaten food security across all continents, whilst replacement land-based aquaculture increases stress on agricultural land.

These issues are not adequately factored into economic analyses governing decision-making

A new and more holistic approach is needed to address costs and benefits of actions taken to govern human interaction with the oceans to acknowledge the reality that:

- Climate change impacts a rapidly growing "blue economy," e.g., fisheries, shipping, ocean energy production, and agriculture, but also increases dependency on it, whilst at the same time depleting the natural capital it represents
- Disproportionate losses and damages are suffered across the planet, with the greatest impact on the most vulnerable (those living in poverty in deltas and on small islands) who, despite low per-capita carbon emissions, face devastating impact, notably displacement. The need for just, fair and equitable collaborative actions to support these vulnerable populations is ever more evident
- Despite much attention having been given to the economic consequences of natural disasters in recent research, in contrast there has been insufficient attention to establishing values for unmonetised environmental impacts such as biodiversity loss, and tipping points owing not just to the often stated role of non-linearities, but that of marginal impacts.

Collective research, innovation and action by governments, the private sector, and civil society at local, national, regional and global levels is needed to understand, expose, and reduce escalating stress on the oceans, including

Locally

Support and encourage collaboration between communities and physical and social scientists and practitioners to support bottom-up approaches (supporting social justice, equity and empowerment of women) and develop nature-based solutions, for example:

- build understanding of the importance of ocean health, utilising tools such as the Climate and Ocean Risk Vulnerability Index (CORVI) and systems health approaches that develop best practices for tasks, e.g., maintaining mangroves, enhancing watershed management and restoration, identifying salt-tolerant

18 IPCC (2019), Summary for Policymakers, op. cit., A.5.

agricultural varieties, implementing nature-based solutions for water treatment, sustainably managing fisheries, reducing losses from tropical cyclones, and optimising benefits from loss and damage funds.

Nationally, regionally, and globally

- support collaboration between earth and environmental science and engineering, public health, and policy making to prioritise development and deployment of early-warning systems, data sharing, and integrated assessment and management methodologies to protect against increasing extreme events (especially for delta and small-island communities)[19]
- promote the integration of aquatic foods into nationally determined contributions[20]
- move beyond existing global processes (e.g. the Barcelona Statement 2024)[21] to include in governance frameworks, regional alliances, and collaborations such as the Regional Platform for Cooperation and Integration in East Asia and its associated networks, and African sustainable development initiatives, with much more proactive consideration of regional impacts on coasts, islands, fisheries and polar seas, as well as the open ocean
- utilise in policy existing models which integrate multiple factors such as economics of ocean use, climate impacts and food production, to show the way to resilient pathways towards the SDG targets
- in particular, urgently develop and utilise in policy holistic, integrated systems approaches to serve as the basis for understanding the interaction between oceans, the economy and society. To this end, further develop digital twins,[22] integrating oceans and economic sciences
- invest in interventions which enhance the sustainability of the oceans as a climate-change solution potentially yielding significant co-benefits, including protecting coastal communities from storms, providing jobs, protecting biodiversity and improving food security
- greatly strengthen international efforts (including with the vulnerable) to build understanding of the physical, social and economic impacts on land of ocean-system disruption under climate change and how to minimise them
- urgently progress global agreements to create alternatives to reshape existing economic incentives to over-produce major ocean pollutants, including, notably, nitrogen, already emerging as "one of the most costly and challenging

19 Schaeffer, M., et al., 2014. *Loss and Damage in Africa*. A UNECA/ACPC report prepared by Climate Analytics. ClimDev-Africa. http://www.climdev-africa.org.

20 Stanford Center for Ocean Solutions, WorldFish, FAO, Beijer Institute, CARE, and EDF (2024), *Integrating blue foods into national climate strategies: Enhancing nationally determined contributions and strengthening climate action*. Stanford Center for Ocean Solutions. https://doi.org/10.25740/cq607gn4098

21 The Barcelona Statement (2024), 2024 Ocean Decade Conference, https://oceanexpert.org/document/34098 , viewed 7 November 2024.

22 Tzachor, A., Hendel, O. and Richards, C. E. (2023), Digital twins: a stepping stone to achieve ocean sustainability? *npj Ocean Sustainability* 2, 16, https://doi.org/10.1038/s44183-023-00023-9

environmental problems"[23] but for which cost-effective solutions exist. And, seek a global treaty to develop alternative materials to achieve plastic-free economies by 2050

- support, strengthen and extend efforts of COPs (IPCC and IPBES) to create new multilateral agreements that address ocean-climate impacts. Reinforce international restoration of coastal ecosystems, including blue carbon, fisheries, and food[24]
- build the above efforts on ecosystem-based approaches to extend at global scale active integrated sustainable adaptation action and the development of global governance structures more appropriate to regulating and protecting marine and coastal ecosystems
- work to develop the necessary strong political will, innovative funding and mutual learning to address common challenges faced by coastal cities, including seeking to avoid involuntary displacement by supporting measures for planned relocation
- initiate innovative approaches, in the absence of a global institution needed to establish ocean governance, by focusing regional, national and non-traditional actors on emerging hotspots of degradation and, in particular, coastal communities, deltas and their rivers.[25] Integrate and support this through a research agenda, and global institutions facilitating (with accountability, and inclusivity) diverse frameworks for implementation, monitoring and management of ocean-related actions.

Conclusion

Human well-being across the Earth depends, to an extensive but poorly recognised degree, on the stability of the planet's oceans, whilst human impacts on them are effectively creating a ticking time-bomb, creating major vulnerabilities where humans live on land. These human impacts on the oceans and the resulting vulnerabilities are insufficiently well understood. Accordingly, we urge all governments to give greater priority to controlling not only ocean areas within their jurisdiction, but also their contributions to the processes driving ocean destabilisation.

Escalating ocean stress is outpacing the development of governance processes that effectively regulate human activity in the ocean commons. In particular, urgent action is required — from local to global — to support the development of effective approaches that address and limit impacts, especially for the most vulnerable, from the multiple interacting stressors increasingly disrupting our planet's oceans.

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24 United Nations (2023), Cordano, J. and O'Dea, N., Informal summary report of the ocean and climate Change dialogue 2023, https://unfccc.int/documents/631689, viewed 7 November 2024.

25 European Commission (2022), International ocean governance, https://oceans-and-fisheries.ec.europa.eu/ocean/international-ocean-governance_en, viewed 7 November 2024.

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26 More details of the RACC and its International Advisory Committee are set out at https://www.stsforum.org/racc2024/iac/

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Thesis abstract

Chemical syntheses, biophysical characterisation and biological investigations of multifunctional anticancer platinum(IV) coordination complexes

Angelico D. Aputen

Abstract of a thesis submitted to Western Sydney University

Cancer kills. It costs many lives. Fortunately, multiple preventative treatment options are available in the clinic. Standard intravenous chemotherapy is the most accepted treatment regimen, which has a reputation as oncology's workhorse. The square planar platinum(II) coordination complexes, cisplatin, oxaliplatin and carboplatin are a clinically renowned class of drugs administered in chemotherapy. Their potency is elicited through covalently binding to deoxyribonucleic acid, which results in crosslinks that activate programmed cell death. Despite their success in treating multiple cancer types, these platinum(II) drugs also exhibit disadvantageous pharmacokinetic and pharmacological effects that greatly impact patient care.

The design of multifunctional platinum(IV) coordination complexes as chemotherapeutic prodrugs is a key research focus in cancer drug design and discovery. This synthetic strategy is working to overcome the clinical challenges associated with platinum(II) drugs. One desirable feature of platinum(IV) complexes is their six-coordinate octahedral geometry, in which two axial coordination sites are synthetically accessible for coordinating bioactive and non-bioactive moieties (or ligands) that can regulate the overall pharmacokinetic and pharmacological properties of the complexes. Axial ligands come in a variety of structural forms and typically with distinct functional groups that can improve the physicochemical properties of the complexes such as aqueous solubility, stability, lipophilicity, rate of reduction, bioavailability and more. Additionally, ligands also carry their own therapeutic properties that can contribute to enhancing the overall anticancer effects of the complexes. Platinum(IV) complexes are also kinetically stable. By adapting to this synthetic strategy, it is possible to create drug prototypes that are effective, well-tolerated and suitable for oral administration. Having chemotherapeutics that can be taken orally and without or with reduced dose-limiting side effects will greatly improve cancer treatment experience.

In this work, multiple platinum(IV) complexes incorporating a distinct selection of bioactive ligands were synthesised. A series of biophysical characterisation techniques, including but not limited to, high-performance liquid chromatography, nuclear magnetic resonance spectroscopy, ultraviolet-visible spectroscopy, circular dichroism spectroscopy, high-resolution electrospray ionisation spectrometry, infrared spectroscopy and elemental microanalysis were utilised to evaluate the purity and confirm the chemical structures of

the platinum(IV) complexes. The resultant and pure platinum(IV) complexes were screened against twelve human cell lines including, HT29 colon, U87 glioblastoma, MCF-7 breast, A2780 ovarian, H460 lung, A431 skin, Du145 prostate, BE2-C neuroblastoma, SJ-G2 glioblastoma, MIA pancreas, the cisplatin-resistant ADDP ovarian variant, and the non-tumour derived MCF10A breast line. Remarkably, their anticancer potential proved to be significantly better than cisplatin, oxaliplatin and carboplatin in most of the cell lines evaluated. Most importantly, the studied platinum(IV) complexes also proved to be potent in the cisplatin-resistant ADDP ovarian variant cell line in comparison to all other cell line populations, indicating that they are not susceptible to the drug resistance mechanisms induced by standard clinical treatment with cisplatin. The results obtained in this work are instrumental in advancing our understanding of cancer treatment. The platinum(IV) prodrugs investigated in this work will allow us to work toward innovative drug design approaches for the treatment of multiple cancers, especially those that are highly aggressive and difficult to treat. This evolving approach to platinum(IV) complexes, as supported by evidence in the literature, has the potential to transform standard chemotherapeutic regimens. Improved knowledge in this research area may alleviate the burden of cancer, giving hope to cancer victims and their families.

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Thesis abstract

Fly (Diptera) pollination efficiency and reproductive needs within crop agroecosystems

Abby Davis

Abstract of a thesis submitted to the University of New England

Global agricultural crop production has become increasingly pollinator-dependant.[1] Eusocial bee taxa within the family Apidae (e.g., honey bees, bumble bees, stingless bees) are well established, successful crop pollinators globally. In particular, the ubiquity and well established management of the European honey bee (*Apis mellifera* Linn., 1758) has resulted in an overreliance of this pollinator worldwide. As other non-bee insects are also effective pollinators, it has become increasingly important to better understand the capability and life history needs of non-bee pollinator taxa so they can provide alternative, or supplementary, pollination services to managed bees and be supported within the landscape. This will ensure that consistent and reliable pollination services continue to be supplied to agricultural systems. This thesis investigates the pollination effectiveness and reproductive needs of the second most important pollinator taxon behind bees, the flies (Diptera), in pollinator-dependant food crops.

First, I conducted a systematic literature review on the diets and habitat needs of 431 crop flower-visiting fly species found globally and collated the existing information into a database. I was able to document the diets and habitat needs of 242 crop-visiting fly species (24 families and 119 genera) inhabiting all eight global biogeographical regions. I found that these crop-visiting fly species live in 35 different natural habitats and belong to 10 different feeding guilds. The results of this review identified major gaps in our understanding of the life history needs of crop-pollinating flies. In particular, current floral management schemes are largely focused on the resource needs of bees. As flies require other non-floral habitats to complete their life cycles, the diverse life history needs of flies and other non-bee taxa are not currently supported by existing pollinator management practices.

Second, I investigated the identity and efficiency of floral visitors to carrot seed crops. To do this, I conducted floral field surveys and pollen deposition trials across two years (2020–21) within varying environmental conditions in the Riverina region of New South Wales (NSW). I conducted 268 floral visitation surveys and identified 53 different insects (26 families) as floral visitors of seed carrot in temperatures ranging from 10.5 °C to 39.5 °C and in 19.7% to 94.7% relative humidity. Spatial and temporal complementarity was observed across all dominant taxonomic groups (ladybeetles, bees, flies). Wild taxa generally matched managed honey bees in terms of abundance and their capability to transfer pollen between carrot parent lines. Further, wild taxa, not managed European honey bees deployed for pollination services, are providing the bulk

1 Chancellor's Doctoral Research Medal 2024

of pollination services to Australian hybrid seed carrot.

Third, I determined the oviposition and habitat needs of pollinating hoverflies (Syrphidae: *Eristalini*). I did this by deploying 14 portable pools filled with soil and decaying vegetation across four seed carrot sites in the Riverina (NSW) region of Australia. All pools successfully supported the immature stages (eggs and larvae) of hoverflies after 12 to 21 days, and two beneficial species of flies were reared from the pools: *Eristalinus punctulatus* and *Eristalis tenax* (Linn., 1758). Both species were effective pollinators of seed carrot in Chapters Three and Four of this thesis, respectively. These results suggest that deploying portable habitat pools filled with decaying plant materials in agroecosystems may be a successful management intervention to rapidly facilitate hoverfly pollinator reproduction.

Fourth, I assessed the effectiveness of the Australasian endemic golden native dronefly *Eristalinus punctulatus* (Macquart, 1847) at transferring pollen to hybrid seed carrot flowers. While both honey bees and the native drone fly were capable of depositing pollen onto seed carrot floral stigmas, golden native drone flies on average deposited more pollen onto stigmas than European honeybees. I also observed the first recorded event of natural oviposition of this fly species on the Mid North Coast (NSW) region. When observing the oviposition of this fly, I found that they oviposited within discarded raspberry plant root balls at a commercial berry farm. This observation, coupled with their demonstrated pollination effectiveness in seed carrot, suggests that these endemic flies could be supported as potential pollinators by deploying non-floral habitat within agroecosystems.

Finally, I compared the pollination effectiveness and activity patterns of two managed fly pollinators and two managed bee species at commercial raspberry and blackberry farms in two major berry growing regions in Australia: Mid North Coast (NSW) and Northern Tasmania (TAS). All taxa were capable of effectively pollinating raspberry and blackberry after one visit to a flower; however, the quality, weight, and number of pollinated drupelets per fruit varied depending on the taxa tested. In small cages, *E. tenax* and wild taxa pollinated raspberry fruits that weighed significantly more and were of higher quality than fruits harvested from *C. stygia* cages; however, there were no significant differences in the quality, weight, and number of pollinated drupelets in blackberry across all taxa. Further, in a blackberry polytunnel in Tasmania, *E. tenax* flies were significantly more active than European honey bees, and the fruits harvested from the *E. tenax* polytunnel did not differ from fruits visited by honey bees. These results demonstrate that some fly species could be effective supplementary, or alternative, pollinators to managed bees in commercial raspberry and blackberry.

This thesis demonstrates the importance of understanding how wild taxa, like flies and non-*Apis* bees, contribute to pollination service delivery, and how best to support these taxa within agroecosystems. Some flies and other wild taxa can provide significant and effective pollination services to some crops. If supported with foraging and habitat needs, these taxa may be able to provide similar pollination services to the honey bees used within these systems. Identifying wild pollinator taxa and their life history needs, assessing their capability as pollinators in a variety of crop systems,

developing rearing techniques to commercialize effective taxa, and methods to support effective wild and managed pollinator assemblages within agroecosystems, are all important next steps to improve pollination services and yields of pollinator-dependant cropping systems globally.

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Thesis abstract

Biophotonics characterisation of up-conversion nanoparticles

Lei Ding

Abstract of a thesis submitted to University of Technology Sydney

Up-conversion materials have attracted enormous attention for a broad range of applications in biological imaging, energy-related light harvesting, and sensing, due to their unique physicochemical properties. However, the comprehensive understanding and characterization of up-conversion nanoparticles for novel applications remain challenging. In this thesis, we set four goals to refresh the present characterization and provide a wider and deeper cognition of these up-conversion nanoparticles. After the delicate design of optical setups and nanomaterials, we realise the property-based resolution enhancement, optical force sensitivity improvement, Rayleigh scattering modulation, and a new water-soluble molecular up-conversion probe.

Experimentally and theoretically, we upgrade the nanoscopy by applying the unique nonlinearity of up-conversion nanoparticles to conventional confocal microscopy. We develop the novel measurement of the three-dimensional optical force of optical tweezers and realize the attonewton-level force sensitivity via revolutionising the configuration and data collection and analysing based on the property of up-conversion nanoparticles. We refresh the morphology-independent method of engineering Rayleigh scattering at the nanoscale level based on the resonance effect of up-conversion nanoparticles. We develop water-soluble molecular up-conversion materials based on the ionic equilibrium of up-conversion dyes.

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Thesis abstract

Conceptualising household flood preparedness: explaining attitudes, coping strategies, and information needs

Willow F. F. Forsyth

Abstract of a thesis submitted to the University of Newcastle

"Unprecedented" flood events are increasing, and catastrophic loss of property and life is the norm despite significant public flood education and warning. This study considers two aspects of the "wicked problem" of the lacklustre pairing of flood intelligence and community engagement. It explores whether authorised systems' generic education and risk communication approaches support households to gain sufficient Know Your Flood Risk (KYFR) capability to a) gauge their personal flood risk exposure (FRE) and b) proactively set coping strategies and, during events, effectively enact response plans.

A total of 58 participants were interviewed during or after significant 2022 flood events in NSW. Qualitative analyses revealed what supports participants' FRE awareness, what coping strategies are chosen, and what is sufficient information to trigger response plans.

By using a theoretical framework that explores the purpose that attitudes to FRE serve, it differs from existing research that studies causal pathways to explain preparedness' beliefs. It overcame two methodological gaps — how to engage publics unfamiliar with the topic, and how to observe their KYFR capabilities.

The study found publics, once aware, are willing but unable to enact response plans. They mostly see official flood information as inaccessible, unactionable, and lacking sufficient local relevance. Official intelligence voids sustain FRE unawareness, feed denial, and fail to explain why-floods-behaved-as-they-did. Unauthorised productive systems emerge to fill these voids.

The study identifies how ten KYFR activities map across coping strategies' response plans (CSRPs) — which differ in complexity, cognitive effort, and motivation. The actionable intelligence (Act-I) model of KYFR is proposed to explain the socio-educative dynamics that amplify the flow of actionable intelligence, inferences, and indicators that fill data voids, provide timely and actionable warnings, and can reduce uncertainty and delays in publics taking protective actions. This thesis makes important contributions to existing knowledge on households' FRE and KYFR attitudes and learning needs.

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Thesis abstract

Essays on household energy poverty and Australia's renewable energy transition

Mara Hammerle

Abstract of a thesis submitted to the Australian National University[1]

Rooftop solar photovoltaics (PV) and household energy efficiency are becoming increasingly important ways to shield households from high energy prices and reduce emissions. However, some households, predominantly those on low incomes and who rent their homes, are at risk of being left behind. This thesis explores (1) how energy poverty and differences in access to residential energy technologies can be addressed and (2) the impacts of such access on household energy consumption and wellbeing. It finds that Australian households with access to rooftop solar PV systems experience large reductions in their likelihood of experiencing objective forms of energy poverty based on comparisons of energy expenditures and incomes. Those with new energy-efficient reverse cycle air-conditioners (RCACs) and hot water systems benefit from reduced energy bills and lowered carbon footprints.

Moreover, public housing tenants in the Australian Capital Territory (ACT) with access to new RCACs report improvements in their health and greater satisfaction with their homes during summer, although there is no statistically significant impact for energy bills stress. A survey of rental providers finds that the key barriers to investment in rooftop solar PV for rental properties are affordability and a belief that renters are unwilling to pay higher rents for the technology. Policies targeted at spreading solar system payments over time or distributing feed-in tariffs to rental providers are found to be not preferred by most rental providers. This thesis collects primary data through three surveys and uses a variety of econometric methods, from discrete choice analysis to instrumental variable regressions and fixed effects panel data regressions. The insights are able to inform future policies on household access to energy innovations, especially for vulnerable cohorts.

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1 ANU 2024 JG Crawford Prize for HASS

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Thesis abstract

Label efficient video and language representation learning and applications

Dongxu Li

Abstract of a thesis submitted to the Australian National University

Video and language research aims to model and analyse the two communication modalities and their connections. Learning effective *video and language representation* is pivotal in facilitating a wide spectrum of applications, such as content-based video retrieval, multimedia content generation, and video-based assistive technology.[1]

Modern deep learning-based video-language models require a large amount of data for supervised training. However, obtaining accurately-annotated video and language data is laborious and expensive, especially for tasks requiring domain expertise. Consequently, existing works usually show compromised results with the limited access to annotations. To this end, this thesis devises *label-efficient algorithms for video and language understanding*, aiming to learn good video and language representations with only a few and/or weak labels. To demonstrate the practical importance of these techniques, we also study extensively their applications on automated video sign language understanding, where annotations are scarce due to the costly domain knowledge required. The main contributions of this thesis are summarised as follows.

First, we present a generic video and language pre-training framework (ALPRO), which learns effective multimodal representations from video-text pairs. Instead of fully-annotated video-text pairs, we use those easily accessible from the web to reduce the demand for human labelling efforts. Specifically, our method aims at capturing alignment between video and text inputs. This is achieved by contrastively aligning unimodal video-text features at the instance level, as well as enhancing the fine-grained alignment between visual regions and textual entities. When transferring to downstream tasks, such as video-and-text retrieval and video question answering, our pre-trained model surpasses previous methods by a significant margin, while using orders of magnitude less training data.

We then describe our efforts in the development of techniques and resources for automated sign language understanding and generation, a typical video and language task where labels are expensive to acquire.

In particular, we study the problem of word-level sign language recognition from videos, aiming at classifying gestures of sign language “words" from videos. Training recognition models for such a task requires video samples with large variations in signer appearance; therefore, scalable datasets with labels are not commonly existent. To tackle this issue, we propose to utilise sign language news videos on public video sharing platforms as an auxiliary data source with weak labels, leading to a self-training

1 ANU 2024 JG Crawford Prize for STEM

framework. We are motivated by the observation that important visual concepts are shared across domains and propose to learn domain-invariant visual descriptors that benefit the recognition.

Our method obtains significant improvement across multiple public datasets, including the largest Word-level American Sign Language recognition dataset (WLASL) developed by ourselves. Apart from showing quantitative advantages over previous works, we also compile the developed techniques into an automatic sign language dictionary, GlossFinder, and demonstrate that such technology and resources help significantly to reduce the learning barriers for sign language learners.

We then study the task of glossification, of which the aim is to transcribe natural language sentences for the deaf to ordered sign language glosses. While the task has important applications in automated sign language video generation, the glossification models suffer from limited gloss annotations. To utilise more efficiently the gloss annotations, we propose to exploit the task priors when designing the glossification model. In particular, we observe that despite different grammar, glosses effectively simplify sentences for the ease of deaf communication, while sharing a large portion of vocabulary with sentences. This has motivated us to implement glossification by executing a collection of editing actions, *e.g.*, word addition, deletion, and copying, called *editing programs*, on their natural spoken language counterparts. Specifically, we design a new neural agent that learns to synthesise and execute editing programs, conditioned on sentence contexts and partial editing results. The agent is trained to imitate minimal editing programs while exploring more widely the program space via policy gradients to optimise sequence-wise transcription quality. Results show that our approach outperforms previous glossification models by a large margin, improving the transcription metrics significantly.

Finally, we study the problem of sign language translation, aiming to translate continuous sign language videos into natural language sentences. Previous works require annotations of ordered signing gestures in the videos, called *glosses*, in order to infer the boundaries between consecutive signing gestures. However, gloss annotations require in-domain sign language expertise and can be time-consuming to obtain. Instead, our model directly learns translation models from sign language videos to natural language sentences without glosses required, exhibiting the potential to extend to a wider range of sign language resources, such as subtitled news videos. We achieve this by proposing a novel sign video segment representation, which takes into account multiple temporal granularities. The model then uses the proposed inter-scale and intra-scale attention modules to adaptively select meaningful gesture segments. In this way, we avoid segmenting gesture boundaries explicitly and alleviate the annotation burdens on glosses and obtain superior results than prior works.

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Thesis abstract

Investigating novel platinum(II) and (IV) complexes with cyclometallated ligands, pyridine derivatives and peptide targeting as potential anticancer agents

Brondwyn McGhie

Abstract of a thesis submitted to Western Sydney University

Cancer takes a huge toll on our society and platinum anticancer drugs are on the frontlines, treating up to 50% of cancer patients worldwide. Currently, these treatments consist of Cisplatin and its derivatives, which have been approved globally since 1978. Although these complexes are efficient cell killers, they are not targeted to cancer and cause severe dose-limiting side effects and are often administered alongside a cocktail of other drugs to alleviate some of these symptoms. Additionally, these complexes are not equally effective in all types of cancer. In fact, some cells are inherently resistant to this mechanism of action and others quickly acquire resistance. To combat these shortfalls scientists have been developing new anticancer agents with alternative mechanisms of action. These unconventional platinum complexes have different Structure Activity Relationships (SARs) and many are active in Cisplatin-resistant cells and are not cross-resistant.

This thesis focuses on 56MESS and its derivatives. These unconventional complexes are formulated with one bidentate polypyridyl ligand (which is a phenanthroline or bipyridine derivative) and a bidentate ancillary ligand (which is usually diaminocyclohexane). These complexes are well known for their cytotoxicity which is 100 times that of Cisplatin. The primary objective of this thesis is to develop new unconventional platinum anticancer complexes with unique biophysical properties and can provide insights into the SAR of these types of complexes. The four main biophysical properties desired were, quadruplex DNA (QDNA) binding, fluorescence, increased platinum(IV) stability and active targeting. These objectives were achieved using unique combinations of ligands, where the polypyridyl ligand was substituted for a cyclometallated ligand or a pyridine derivative. These complexes showed remarkable fluorescent properties, stability and DNA binding properties as well as having good cytotoxic profiles. Additionally, active targeting of 56MESS was explored, and new biological techniques were investigated to find effective techniques for the preliminary assessment of anticancer prodrugs. The complexes synthesised have been separated into four main chapters that have been reported in four publications and an additional chapter that focused on active targeting and cell culture work.

The first project develops QDNA stabilising cyclometallated complexes, designed with one cyclometallated ligand and one polypyridyl, phenanthroline-based ligand to achieve a large positively charged surface area to stack onto QDNA. Several of these complexes were significantly more cytotoxic

than Cisplatin in all cell lines tested and had good to moderate selectivity indices, 1.7–4.5 in MCF10A/MCF-7. The fluorescence explored was found to have relatively high emission quantum yields (up to 0.064) and emission occurred outside cellular autofluorescence, meaning their fluorescence is ideal for *in vitro* analysis. The second project investigates the use of cyclometallated ligands that are close relatives of the typical ligands used in 56MESS and its derivatives, looking at the utility of the stabilising effect of cyclometallation as well as the fluorescence it produces. This group of complexes was found to have a similar cytotoxic profile to Cisplatin, and all had very high selectivity indexes compared to previous Pt(II) complexes. They were determined to have a good affinity to calf thymus DNA (ctDNA), and their fluorescence was successfully utilised in benchtop binding experiments. The next project looks at oxidising these cyclometallated complexes and how their platinum(IV) derivatives differ from Pt(IV)56MESS, again investigating the utility of the stabilising effect of cyclometallation and changes to fluorescence upon oxidation. The cyclometallation had an extreme stabilising effect increasing the reduction half-life by 30-fold. These platinum(IV) complexes also saw improved cytotoxicity compared to previous 56MESS-type complexes. The fourth chapter investigates imidazole and pyridine derivatives as alternative polypyridyl ligands in the 56MESS formula, looking at changes in their DNA binding and cytotoxicity. These complexes were determined to have good DNA binding properties and had a similar average cytotoxicity to Cisplatin but had remarkable variation within different cell lines suggesting they may have some inherent selectivity. The final chapter starts to investigate the use of prostate membrane antigen (PSMA) targeting ligand DCL in targeting Pt(IV)56MESS and offers new perspectives on the utility of MTT assays in assessing prodrugs.

For each novel complex, the synthetic strategy has been developed to produce good yields and high purity (>95%). Each was assessed using high-performance liquid chromatography (HPLC) for purity, and a combination of nuclear magnetic resonance spectroscopy (NMR), ultraviolet (UV) and circular dichroism (CD) spectroscopy and electrospray ionisation mass spectrometry (ESI-MS) to confirm structure and basic chemical properties. In addition, the lipophilicity of each complex was calculated using HPLC techniques, and fluorescence parameters and quantum yields were determined for all fluorescent complexes. To assess the biological activity of these complexes their cytotoxicity was determined against a panel of cancer cell lines and their DNA binding was investigated using a variety of techniques including DNA melting and fluorescent displacement experiments. For the platinum(IV) complexes additional reduction half-life experiments were undertaken.

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Thesis abstract

On the Edge: the power of place, trauma and memory at South Head

Sinead Roarty

Abstract of a thesis submitted to University of Technology Sydney

The Gap at South Head in Sydney's eastern suburbs is a place of extreme beauty. It is also famous for being Australia's most well-known suicide destination.

This non-traditional PhD consists of an exegesis and a creative work, which together form an interrogation and creative re-imagining of the site's overlapping narratives, multiple silences, and history of violence and loss. The exegesis and site-specific soundwork offer an exploration of how it might be possible to build a radically alternative narrative of place that disrupts a continuing legacy of violence.

Through primary historical research and through the lens of theorists of place (Casey, Irish, Karskens, Carter, Massey, and Thomas), the exegesis traces an affective thread connecting the unresolved wounds of frontier violence to racial and gendered violence and the acts of self-annihilation that tragically persist there today. It examines critical events and texts in the colonial naming and imagining of South Head to unpick the way they have enacted a violent cultural logic in constructing South Head as an active "gap," and it considers whether the critical terms "badland" and "traumascape" (Gibson and Tumarkin) can be usefully applied to this place, while offering "ruptured space" as an alternative term for describing a category of place that has endured profound "rupture" to help it refuse to be forever cast as doomed. By utilising this term, the thesis posits a new narrative that both acknowledges a fractured sense of place and disrupts a continuing legacy of violence. Ultimately, "On the Edge" enhances our knowledge about placemaking and Australia's connection to its place in the world and considers whether reimagining this site might help us understand other layered places of silenced violence. In addition, by employing a psychogeographical approach to the fieldwork through a series of interpellated "passages" (Beudel and Debord), the exegesis offers an alternative lived experience to the multiple layers of this unsettled site, which includes the institutional, criminal, geological, energetic and more-than-human.

Inspired by artists who use digital technologies to harness affect and empathy (Cardiff+Miller, Milk, Parragirls), the immersive site-specific soundwork is offered as an experiment in how we might use affective artforms to transform the experience of being in-place. The soundwork engages with this site by enacting a fragmentary set of silences to create an artefact that allows those silences to resonate and aid in its restitution.[1]

1 The soundwork can be accessed at https://www.ontheedge.space/ and is best experienced on-site at Don Ritchie Grove, South Head. Please wear earphones for a fully immersive VR experience.

Combined, the exegesis and creative work consider whether this approach to this complex site might help us understand other layered places of silenced violence.

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Thesis abstract

Generalizable and robust machine learning with imperfect data supervision

Shuo Yang

Abstract of a thesis submitted to University of Technology Sydney

Modern machine-learning systems, particularly deep neural networks, have driven advancements in many artificial-intelligence domains. Their success largely depends on ample, high-quality labelled data for training. However, consistently accessing such data isn't always possible due to privacy, ethical, or economic barriers. Real-world situations often present data that is limited in quantity or compromised in quality. For example, medical datasets are sparse due to privacy concerns, and multi-modal datasets are frequently noisy, as they are routinely sourced from the internet or labelled via crowd-sourcing platforms. These imperfect data conditions lead to suboptimal deep-learning models that are prone to overfitting, biased or noisy data distributions. This thesis strives to provide theoretical understanding, empirical analysis, and methodological solutions for training resilient and universally applicable deep-learning models under such imperfect data-resource supervision.

In addressing the problem of generalizable learning with scarce data, the distribution bias issue is first analysed. A few data points usually form a biased data distribution. A discrepancy between the biased and ground-truth data distributions is identified as the root cause of poor generalisation in deep models. A distribution calibration technique is introduced to rectify this bias, helping models trained on sparse data to maintain high performance. Subsequently, a technique, named dataset pruning, is proposed to determine the minimum necessary training data size, ensuring consistent performance between models trained on the full and pruned datasets. Observations from pruning several large-scale datasets show that a small portion can nearly match the original's performance, underscoring the surprising capability of minimal training data points.

Turning attention to the problem of robust learning with noisy data, the investigation begins with label noise in the classification task, wherein label noise manifests in the form of categorical annotation errors. A parametrical model is proposed to bridge the distribution gap between noisy labels and clean labels and significantly improve the robustness of the learned model. It is further shown that a classifier trained on the noisy dataset will asymptotically converge to the Bayes optimal classifier with an optimal convergence rate. The label-noise problem is then extended to a more realistic and challenging context, namely, multi-modal learning, where the label noise refers to alignment errors in paired data. To tackle this, a general framework termed BiCro (Bidirectional Cross-modal similarity consistency) is proposed. This framework can be conveniently integrated into exist-

ing multi-modal learning models, thereby augmenting their resilience to noisy data.

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Royal Society of New South Wales 2024

Awards Winners 2024

The Awards for 2024 were announced at the 1328th Ordinary General Meeting of the Society, held on Wednesday, 4 December 2024.

Four Career Excellence Awards

2024 RSNSW James Cook Medal

Scientia Professor George Paxinos AO FAA FASSA FAHMS DistFRSN

2024 RSNSW Aboriginal and/or Torres Strait Islander Scholars Medal

Professor Jason Sharples FTSE FRSN

2024 RSNSW Edgeworth David Medal

Professor Yansong Shen

2024 RSNSW Ida Browne Early Career Medal

Dr Xuan Li

Five Discipline Awards and Medals

2024 RSNSW Pollock Award and Lectureship in the Physical Sciences and Mathematics

Professor Nalini Joshi AO FAA FRSN FaustMS

2024 RSNSW Interdisciplinary Award

Professor Katherine Boydell FASSA

2024 RSNSW Award in the Humanities, Philosophy and Law

Scientia Professor Jane McAdam AO FASSA FAAL

2024 RSNSW Poggendorff Award and Lectureship in Agricultural and Environmental Science

Professor Alexander McBratney AO FAA

2024 RSNSW Jak Kelly Award

Mr David Sweeney

Three 2024 RSNSW Bicentennial Early Career Research and Service Citations

Dr Cynthia Turnbull, Dr Fei Deng, Dr Jen Matthews

Three 2024 RSNSW Bicentennial Postgraduate Scholarships

Joel Sved (University of Sydney), *Linqing Tian* (UNSW Sydney), *Muyong Li* (University of Sydney)

Two 2024 RSNSW Royal Society Service Awards

Scientia Professor Emerita Eugenie Lumbers AM DistFRSN FAA, Ms C. Hannah Hibbert

Four Career Excellence Awards

2024 RSNSW James Cook Medal

Scientia Professor George Paxinos AO FAA FASSA FAHMS DistFRSN

The James Cook Medal is awarded for the most meritorious lifetime contributions to knowledge and society in Australia or its territories made by an individual and conducted mainly in NSW. The James Cook Medal was established by the Council in 1943 following a donation made by Henry Ferdinand Halloran to celebrate his 50 years as a member of the Society and it has been awarded periodically since 1947. In 2023, the Council determined to award it annually.

Professor Paxinos is a visionary of neuroscience and the world's leading brain cartographer. He has published 59 books, his first book being the most highly cited Australian publication of all time. His stereotaxic atlases of the brain and spinal cord of humans, rats, mice and monkeys have proven critical in facilitating research into the relationship between the human brain and neurologic or psychiatric disease, as well as animal models of these diseases, and assisting the development of psychotherapeutic drugs and accurate interventions in the human brain. His eminent lifetime contributions to neuroscience make him an exceptional James Cook Medal candidate.

2024 RSNSW Aboriginal and/or Torres Strait Islander Scholars Medal

Professor Jason Sharples FTSE FRSN

The Aboriginal and/or Torres Strait Islander Scholars Medal is awarded for the most meritorious contributions to knowledge and society made by scholars identifying as Australian Aboriginal or Torres Strait Islander and conducted mainly in NSW. The Aboriginal and/or Torres Strait Islander Scholars Medal was established by the Council in 2023 to reflect the full scope of the Society's values.

Professor Sharples is renowned as one of the world's leading experts in wildfire science. A proud Wahlabul Bundjalung man, he has made outstanding research contributions that have substantively improved our understanding of fire weather, fuel moisture modelling, wildfire risk assessment, fire-fighter safety, dynamic fire behaviour, fire-atmosphere interac-

tions, and extreme wildfire development. His paradigm-shifting contributions are widely acknowledged as leading international thought on how the problem of wildfires should be approached around the world, and under his leadership, the Bushfire Research Group at UNSW has emerged as a global leader in the interdisciplinary field of wildfire science.

2024 RSNSW Edgeworth David Medal

Professor Yansong Shen

The Edgeworth David Medal is awarded for the most meritorious contributions to knowledge and society in Australia or its territories, conducted mainly in NSW by an individual who is from 5–15 years post-PhD or equivalent on 1 January of the year of the award. The Edgeworth David Medal was established by Council in 1943 in honour of Sir T. W. Edgeworth David FRS, who compiled the first comprehensive record of the geology of Australia, and following a donation made by Henry Ferdinand Halloran to celebrate his 50 years as a member of the Society. It has been periodically awarded since 1948. In 2023, the Council determined to award it annually.

The mass deployment of photovoltaic solar panels plays a vital role in Australia's meeting the Net Zero 2050 targets. Importantly, at the end of their life these panels must be recycled to enable genuine life-cycle Net-Zero and to meet Australia's Waste Action Plan. Unfortunately, current photovoltaic solar-panel recycling consists of simply stripping the aluminium frames and sending the rest to landfill. In an Australian first, and inspired by metallurgy engineering, **Professor Shen** has developed a sustainable, full-loop system for end-of-life solar panels. This environmentally-friendly recycling process not only diverts waste from landfill but also provides materials for new solar panel manufacturing.

2024 RSNSW Ida Browne Early Career Medal

Dr Xuan Li

The Ida Browne Early Career Award recognises the most meritorious contributions to knowledge and society in Australia or its territories by an individual from 0–5 years post-PhD or equivalent on 1 January of the year of the award and conducted mainly in NSW. The Ida Browne Medal was established by the Council in 2023 in honour of Ida Browne DSc, a palaeontologist and the first woman President of the Royal Society of NSW, who served from 1953–1954.

Dr Li is a leading figure in environmental engineering, renowned for her innovative work in corrosion mitigation, wastewater-based infectious disease surveillance, and energy-efficient wastewater treatment. Her corrosion-resistant concrete extends sewer lifespan by 40%, reducing costs and maintenance needs while delivering substantial economic and environmental benefits. She was an early contributor to wastewater-based COVID-19 surveillance, demonstrating its reliability and establishing the world's first accurate predictive system for infection and hospitalisation rates, surpassing existing models in lead time and precision. Additionally, she has pioneered waste-driven technologies that enhance energy recovery in wastewater treatment, significantly benefiting water utilities. Dr Li's research has been widely tested by water industries and recognised by global organizations. Beyond

her research, Dr Li is actively involved in mentoring and outreach, regularly presenting at industry events and inspiring the next generation of scientists. Her remarkable contributions have earned her numerous awards, such as the Australian Academy of Science Award, and the Eureka Prize for Environmental Research. As the sole/lead CI, she has secured over $1.2 million in research funding, such as the ARC DECRA Fellowship and the UTS Chancellor's Fellowship. Her work has been featured in over 100 media outlets, including major networks such as Fox8 (AU) and ABC (US).

Five Discipline Awards and Medals

2024 RSNSW Pollock Award and Lectureship in the Physical Sciences and Mathematics

Professor Nalini Joshi AO FAA FRSN FaustMS

Awarded for distinguished research in any area of the Physical Sciences and Mathematics, excluding the Chemical and Earth Sciences, conducted mainly in NSW. The Pollock Memorial Lectureship was first awarded in 1949, sponsored by the University of Sydney and the Society, in memory of J.A. Pollock, Professor of Physics at the University of Sydney (1899–1922) and a member of the Society for 35 years. In 2023, the Council designated it the Royal Society of NSW Pollock Award and Lectureship.

Professor Joshi has made ground-breaking contributions to mathematical modelling of nonlinear systems; particularly, innovative methods involving transcendental functions and Painlevé equations. Her research clarifies complex behaviours across various scales, significantly impacting fluid dynamics, nonlinear optics, and lattice theory. Recognised nationally and internationally, she is an Officer of the Order of Australia and has received multiple prestigious awards, including the George Szekeres Medal. She has supervised 18 PhD students and guided over 30 early-career researchers from across the world, earning the Eureka Prize for her commitment to mentoring. Joshi also founded the SAGE initiative, promoting gender diversity in STEM fields.

2024 RSNSW Interdisciplinary Award

Professor Katherine Boydell FASSA

Awarded for distinguished research which spans across disciplines, conducted mainly in NSW. Council established the Royal Society of NSW Interdisciplinary Award in 2023 to reflect the full scope of the Society's founding values.

Professor Boydell is an internationally recognised leader in qualitative inquiry and arts-based knowledge translation in metal health and social care. She has a long-standing, successful history in the development of innovative methodological approaches to create knowledge and translate empirical research using arts-based methods. As the founder and lead of the Arts-based Knowledge Translation Lab, she has developed a coordinated strategy to transform consumer participation in mental health research, drawing on the arts to communicate public awareness of mental health, decreasing stigma, expanding the research

base and creating global partnerships in innovative, whole-of-community approaches to mental health and well-being.

2024 RSNSW Award in the Humanities, Philosophy and Law

Scientia Professor Jane McAdam AO FASSA FAAL

Awarded for distinguished research in any area of the Humanities, Philosophy and Law, excluding the History and Philosophy of Science, conducted mainly in NSW. Council established the Royal Society of NSW Humanities, Philosophy and Law Award in 2023 to reflect the full scope of the Society's founding values.

Displacement remains one of the biggest human-rights challenges of our time, with conflict, human-rights abuses, disasters and climate-change impacts having driven more than 100 million people from their homes globally. Much can be done to alleviate displacement and its human costs — if we act with clear leadership and strategic, solutions-oriented thinking. **Professor McAdam** is at the forefront of such thinking, working with governments, affected communities, civil society and international organisations to develop effective responses. Indeed, her pioneering research on climate mobility is directly influencing policy from Guatemala to Geneva and making a real difference for people on the ground.

2024 RSNSW Poggendorff Award and Lectureship in Agricultural and Environmental Science

Professor Alexander McBratney AO FAA

Awarded for distinguished research in any area of the Agricultural and Environmental Sciences, conducted mainly in NSW. The Poggendorff Award and Lectureship honours Walter Poggendorff, an eminent biologist and noted plant breeder in the 1930s and '40s, and his bequest to the Society to support a Lectureship. It was first awarded in 1987 and in 2023 Council designated it the Royal Society of NSW Poggendorff Award and Lectureship.

Professor McBratney's pioneering work in precision agriculture, and digital soil mapping has revolutionized soil science and agricultural practices, enhancing Australian agricultural productivity by at least $60 million annually and reducing environmental impact. His revolutionary theories and models have transformed access to soil information for farmers which, in turn, informs advances in sustainable farming practices. Global uptake of his digital tools and training programs have strengthened soil care and fostered AgTech businesses worldwide. His contributions address soil erosion, salinisation, and acidification, improving food security and biodiversity while influencing international soil security policies.

2024 RSNSW Jak Kelly Award

Mr David Sweeney

The RSNSW Jak Kelly Award recognises excellence in postgraduate research in physics annually. The Award is supported by the Royal Society and the Australian Institute of Physics, NSW Branch. The winner is selected from presenters at each year's Australian Institute of Physics NSW Branch Postgraduate Awards, as advised to the Awards Committee of the Royal Society of NSW. The Jak Kelly Award was created in honour of Professor Jak Kelly

(1928–2012), who was Head of Physics at University of NSW from 1985 to 1989 and Honorary Professor of University of Sydney from 2004. He was President of the Royal Society of NSW in 2005 and 2006.

Mr Sweeney was awarded the Jak Kelly Prize for his excellence in postgraduate research in physics, and more specifically his work as a PhD student and lead author of "The Galactic underworld: the spatial distribution of compact remnants," published in *Monthly Notices of the Royal Astronomical Society*, with others.

Three 2024 RSNSW Bicentennial Early Career Research and Service Citations

The RSNSW Bicentennial Early Career Research and Service Citations are awarded each year to recognise outstanding contributions to research and service to the academic and wider community. Applicants must on 1 January of the year of nomination be no more than 5 years after the award of their PhD or equivalent by a university or other research institution in NSW or the ACT.

For 2024, three RSNSW Early Career Citations have been awarded:

- Dr **Cynthia Turnbull** — Australian National University
- Dr **Fei Deng** — UNSW Sydney
- Dr **Jen Matthews** — University of Technology Sydney

Dr Turnbull is a postdoctoral researcher at the John Curtin School of Medical Research, Australian National University (ANU). Her PhD with Professor Carola Vinuesa focused on the role of genetic mutations in severe autoimmune disease. Currently, she works in the laboratory of Professor Si Ming Man and studies the role of innate immunity in inflammation and cancer. Outside of the lab, Cynthia has a passion for teaching and science communication. She has provided guest lectures at ANU, been invited to present at Australian and international research institutes and conferences and has featured in several media articles and radio talk shows.

Dr Deng is currently a researcher in the Graduate School of Biomedical Engineering, UNSW. Dr Deng received his PhD (Biomedical Engineering, 2021) from UNSW. His research interests include point-of-care biosensing devices, CRISPR biosensing devices and in vivo biosensing devices. Dr Deng has published over 30 journal articles, including in *Nature Communications*. In addition, he has secured over $10m in research grants. His biosensor research has been well recognised by industry, leading to a start-up company (Casbio Pty Ltd).

Dr Matthews is Deputy Team Leader of the Future Reefs Group at the University of Technology Sydney. Her research has transformed our understanding of coral nutrition and the physiology of corals in NSW, vital for local policy. Collaborating with Traditional Owners, she develops practical solutions to coral ecosystem challenges. With more than 50 invited presentations and 17 awards such as the 2023 NSW Tall Poppy Award, her global impact is clear. Jen has published 32 papers (*h*-index: 14) and secured 13 grants exceeding $3.4m. Her commitment to science communication and mentoring was recognised by the 2021 Science Technology Australia Superstars of STEM program.

Three 2024 RSNSW Bicentennial Postgraduate Scholarships

The RSNSW Bicentennial Postgraduate Scholarships are awarded each year to recognise outstanding achievements by young researchers in any academic field. Applicants must have completed an undergraduate degree within NSW or the ACT and must on 1 January of the year of nomination be enrolled as research students in the first or second year of their first higher degree at a university or other research institution in NSW or the ACT.

For 2024, three RSNSW Scholarships have been awarded:

- **Joel Sved** — University of Sydney
- **Linqing Tian** — UNSW Sydney
- **Muyang Li** — University of Sydney

The paper by **Joel Sved**, S. Song, Y. Chen, L. Zhou, R. Minasian, and X. Yi, "Machine learning assisted two-dimensional beam-steering for integrated optical phased arrays," (*Optics Communications*, 540, 2023), introduces the first machine-learning-assisted method for achieving high-precision 2D beam-steering in optical phased arrays. This ground-breaking approach, designed to overcome fabrication imperfections, thermal crosstalk, and ambient temperature variations, was experimentally validated on a silicon-on-insulator (SOI) platform. The technique demonstrates significant potential for a wide range of applications, including LiDAR, imaging and sensing systems, free-space optical communications, as well as augmented and virtual reality technologies.

Leveraging her extensive expertise in polymer science and computational modelling, alongside her innovative approach to nanomedicine, **Linqing Tian** developed a novel drug-delivery system that enhances the delivery of therapeutic drugs without relying on organic solvents. This sustainable system, which uses sugars and amino acids, allows for the formation of nanomedicine in an aqueous environment. It streamlines the process by eliminating the need for multiple steps and enables precise control over nanoparticle size by adjusting the quantity of the added drug. Versatile and easy to adapt, this system is suitable for a wide range of therapeutic drugs.

Muyang Li's academic records are impressive — only in his second year, he has thus far published 9 peer-reviewed articles in top conferences and journals of our area, his papers have been cited 130 times in the past two years. His research excellence has been recognised by different entities, such as Google Award for best poster in AI/ML from the University of Sydney and Google, outstanding reviewer award from ICLR 2024, finalist in the renowned Data Science PhD fellowship from Bloomberg, and he has been recommended by his school for the application of Apple Scholar for the round of 2025.

Two 2024 Royal Society Service Awards

2024 Royal Society Service of NSW Medal

The Royal Society of New South Wales Medal recognises an individual who has made meritorious contributions to the advancement of knowledge in any field and also to the Society's administration, organisation, and endeavours. The RSNSW Medal was first awarded in 1884, revived in 1943, and has been awarded periodically thereafter.

Scientia Professor Emerita Eugenie Lumbers AM DistFRSN FAA

Eugenie Lumbers researched and taught physiology and pharmacology at UNSW for 30 years, serving on its Council and becoming Scientia Professor in 2003. She was elected as a Fellow of the Australian Academy of Science in 2002 and received Membership in the Order of Australia in 2012. In 2006 she joined RSNSW, becoming a Fellow in 2010 and a Distinguished Fellow in 2011. A member of the RSNSW Council, she chaired the Society's Awards Committee at a critical time in 2020 and was the motivating force in the creation of the Hunter Branch of the Society in 2019, serving on its committee ever since.

2024 Royal Society of NSW Service Citation

The Royal Society of New South Wales Citations recognise individuals who have made significant contributions to the Society, but who have not been recognised in any other way. The RSNSW Citation was first awarded in 2019.

Ms C. Hannah Hibbert

Hannah Hibbert is an accomplished archivist with formal credentials and roles as the archivist for the Australian Turf Club and, currently, the Sydney Opera House. Serving as the Honorary Archivist for the Royal Society of New South Wales from November 2019 to April 2024, Hannah played a key role in the Society's bicentenary exhibition and online listing of the Society's extensive archives. From 2011, Hannah volunteered countless hours investigating and documenting the material held by the Society at 121 Darlington Road, Darlington. This was a challenging task. In 2012, Hannah produced a spreadsheet that identified over 500 records and objects, with an assessment of their condition, significance, and a comprehensive set of notes where appropriate. Hannah continued to develop this over subsequent years in the period leading up to her appointment as Honorary Archivist. Hannah is President of the Australian Society of Archivists.

Events in 2024

Meetings were held by the Society in five places: Sydney; Newcastle by the Hunter Branch; Mittagong by the Southern Highlands Branch; western NSW by the Western NSW Branch; and, as of November 2024, Armidale by the New England North West Branch.

1319th OGM and Open Lecture

Emeritus Professor Roy Green AM FRSN, "Productivity: what it is, and why it matters," 7 February, Metcalfe Theatre, State Library of NSW. (See the paper in this issue.) https://www.youtube.com/watch?v=kgKjzlphgeo

Southern Highlands Branch Meeting 2024-1

Susannah Fullerton OAM FRSN, "Ten novels that changed the world," 15 February 2024, RSL Mittagong, Carrington Room.

Hunter Branch Meeting 2024-1 with the Australian Decorative and Fine Arts Society

Dr Martina Mrongovius, "Exploring the Holographic," 19 February, Hunter Theatre, Cameron Street, Broadmeadows, NSW

Annual Meeting of the Four Societies 2024

Vince Di Pietro AM CSC FRSN FRAeS FAICD, "Resilience before Readiness: '… for the want of a horseshoe nail'," 21 February 2024, Metcalfe Theatre, State Library of NSW. https://www.youtube.com/watch?v=ubRWpOBC-qs

Western NSW Branch Meeting 2024-1

Professor Shokoofeh Shamsi, "Parasites, Australia's silent threat: coincidence, nature's hand, or policy complacency," 28 February 2024, Wagga Wagga campus (Riverina Playhouse), Charles Sturt University https://www.youtube.com/watch?v=-Do4_hfx2Fs

RSNSW 2024 Annual Dinner and Presentation of Awards

1 March 2024, Strangers' Room, Parliament House, Sydney.

Ideas@theHouse: March 2024

John Bell AO OBE, "Shakespeare on politics — what can we learn?" 6 March 2024, Government House, Sydney. (See the paper in this issue.) https://www.youtube.com/watch?v=-VO07eEpIpk

RSNSW 2023 Student and Early Career Research Award Presentations

Dr Jaime Alvarado-Montes, Macquarie; Ms Sasha Bailey, Sydney; Mr Jayden McKinnon, Wollongong; Dr Jacinta Martin, Newcastle; Dr Abhimanu Pandey, ANU; Dr Shoujin Wang, UTS. 13 March 2024, Western Sydney University Parramatta South Campus, Old Female Orphan School.

Hunter Branch Annual General Meeting 2024

21 March 2024, Zoom webinar.

Southern Highlands Branch Meeting 2024-2

Professor Allen Nutman, "The antiquity of life: Oldest (3.7 billion years old) stromatolite fossils discovered in Greenland," 21 March 2024, RSL Mittagong, Carrington Room.

Frontiers of Science Forum 2024

Prof John Mattick, UNSW Sydney; Dr Renee Goreham, University of Newcastle; Prof Katrina Jolliffe, University of Sydney; Assoc Prof Richard Garner, Macquarie Univ. "Exploring major discoveries and theories in physics, mathematics, biology, and chemistry," 22 March 2024, Concord Golf Club, 190 Majors Bay Road, Concord.

Western NSW Branch Meeting: 2024-2

Professor Alan Cooper, "Out of Arabia: how ancient human history gave us modern lifestyle diseases," 10 April 2024, Port Macquarie campus (Building 802, Room 2330/7, Major Innes Road), Charles Sturt University.

Hunter Branch Meeting 2024-2

Honorary Professor Michael Mahony AM, "Conservation, frogs, and citizen science," 11 April 2024, King Street Room, NEX, Newcastle Exhibition and Convention Centre.
https://www.youtube.com/watch?v=zS2dIJ_bitc

1320th OGM and Open Lecture

Emeritus Professor Peter Shergold AC FRSN FASSA and Professor Kirsty Muir "Putting the 'Civil' Back in Civil Society," 17 April 2024, Metcalfe Theatre, State Library of NSW.
https://www.youtube.com/watch?v=BvPjaXBcQNo

Southern Highlands Branch Meeting 2024-3

Professor Fred Watson AM, "Webb's wondrous window on the Universe," 18 April 2024, RSL Mittagong, Carrington Room.

1321st OGM and Open Lecture

Scientia Professor Kaarin Anstey FRSN FASSA FAHMS, "Brain Health Equity — a new frontier for healthy longevity," 1 May 2024, Zoom webinar.
https://www.youtube.com/watch?v=lOZdiWzCKi4

Joint RSNSW and State Library of NSW Special Event: May 2024

Emeritus Professor Dennis Reinhartz and Emeritus Professor Robert Clancy AM FRSN "On the history of Russian conflict with Ukraine," 3 May 2024, Maps Room, State Library of NSW.

Southern Highlands Branch Meeting 2024-4

Distinguished Professor Anatoly Rozenfeld FRSN, "Latest advances in radiation therapies for cancer," 16 May 2024, RSL Mittagong, Carrington Room.

1322nd OGM and Open Lecture

Professor Pall Thordarson FRSN, "RNA and me: from the origins of life and nanomedicine to building an RNA ecosystem," 5 June 2024, Dixson Room, Mitchell Building State Library of NSW. https://www.youtube.com/watch?v=8CbHmRo2gHs

Joint AIP, RACI, RSNSW, and ANSTO Event: June 2024

Professor David Cohen FTSE FAIP, "Electrifying discoveries: using particle accelerators to research air pollution, radiobiology, and electronic chips that go into space," 18 June 2024, ANSTO, New Illawarra Road, Lucas Heights.

Southern Highlands Branch Meeting: 2024-5

Dist. Professor Gordon Wallace AO FAA FTSE FRSN, "Getting technological advances into the clinic — things I wish I'd known 20 years ago!" 20 June 2024, RSL Mittagong, Carrington Room.

Western NSW Branch Meeting: 2024-3

Professor Muhammad J. A. Shiddiky, "Onsite and POC Testing: Improving biomedical and agricultural diagnostics and analysis," 26 June 2024, Orange campus (Building 1008, Room 206), Charles Sturt University. https://www.youtube.com/watch?v=r_lgL8otTVo

1323rd OGM and Open Lecture

Professor Sir Michael Marmot CH FRCP FFPHM FMedSci FBA, "Social Justice and Health Equity," 3 July 2024, Zoom webinar. https://www.youtube.com/watch?v=yDiI9csMHmI

Ideas@theHouse: July 2024

Julie Inman Grant, eSafety Commissioner, "W × 3 — The World Wide Web (we weaved)," 18 July 2024, Government House Sydney. (See the paper in this issue.)
https://www.youtube.com/watch?v=nSFVrIugy3E

Southern Highlands Branch Meeting 2024-6

Dr Brad Tucker, "Space Race 2.0." Scheduled for 18 July 2024, this event was cancelled.

Hunter Branch Meeting 2024-3

Laureate Professor Clare Collins AO, "Are you what you eat? Discovering the science of personalised nutrition," 19 July 2024, The University Conservatorium, Laman Street, Cooks Hills, Newcastle. https://www.youtube.com/watch?v=Pp4MlY7IEYg

1324th OGM and Open Lecture

Medy Hassan OAM FRSN (Facilitator) together with an expert panel, "Our Housing Crisis: Dissolving Barriers and Delivering Solutions," 7 August 2024, Metcalfe Theatre, State Library of NSW. https://www.youtube.com/watch?v=lpS336YR00Y

Southern Highlands Branch Meeting 2024-7

Professor Carolyn Hogg FRSN, "Biodiversity, bilbies, and battling extinction," 15 August 2024, RSL Mittagong, Carrington Room.

Western NSW Branch Meeting: 2024-4 (joint with Charles Sturt University)

Professor Leslie Weston FAA, "Adapting to change — invasive plants and pests take up the challenge," 28 August 2024, CSU Riverina Playhouse, 8 Cross Street, Wagga Wagga.
https://www.youtube.com/watch?v=YvzNyOjdHpQ

Joint UNE and RSNSW Presentation

Professor Yihong Du FAA, "Mathematics for propagation and the spreading of species," 3 September 2024, NOVA, 122 Faulkner Street, Armidale.
https://www.youtube.com/watch?v=8qv9icmeOlA

1325th OGM and Open Lecture

Emeritus Professor Bruce Chapman AO FASSA, "HECS-HELP: History, effects, international comparisons, and the University Accord," 4 September 2024, Zoom webinar.
https://www.youtube.com/watch?v=XWDeQDm-lTU

Southern Highlands Branch Meeting 2024-8

Scientia Professor Gordon Parker AO FASSA FAHMS, "Secrets of ageing with resilience," 19 September 2024, RSL Mittagong, Carrington Room.

1326th OGM and Open Lecture

Dr Anne Coote, Historian and Author, Book Launch: The RSNSW origin story, 2 October 2024, Metcalfe Theatre, State Library of NSW. (See the papers in this issue.)
https://www.youtube.com/watch?v=To_QO2Fb-mc

Southern Highlands Branch Meeting 2024-9

Professor Michael Kassiou FRACI FRSC FAFMC FSRS, "The Chemistry of Social Anxiety," 7 October 2024, RSL Mittagong, Carrington Room.

First of the Lunchtime series: Provocations and Inspirations

Dr Ken Henry AC, "Inequality in Australia," 22 October 2024, Union University and Schools Club, 25 Bent Street, Sydney. (See the paper in this issue.)
https://www.youtube.com/watch?v=8RUUFEwI-e4

Western NSW Branch Meeting 2024-5

Distinguished Professor Sarah O'Shea, "Equity within the Academy: Rethinking the 'why' of higher education," 23 October 2024, CSU Dubbo Campus Bldg 901, Room 121, 8 Tony McGrane Place, Dubbo. https://www.youtube.com/watch?v=nDwirsuLN4w

Hunter Branch Meeting 2024-4

Professor Francesco Paolucci, "How can we afford the healthcare system of our dreams?" 24 October 2024, Vivid Room, NEX, Newcastle Exhibition and Convention Centre. https://www.youtube.com/watch?v=Ftgwxl23fsU

Ideas@theHouse: October 2024

Professor Tim Stephens FAAL, "The big thaw: who governs Antarctica's ice?" 31 October 2024, Government House Sydney, and live stream. https://www.youtube.com/watch?v=XiHTYy5_dfw

1327th OGM and Open Lecture

Dr Abul Rizvi PSM, "Australian immigration policy and the Federal election," 6 November 2024, Zoom webinar. https://www.youtube.com/watch?v=29-UwSoebOg

RSNSW and Learned Academies Forum 2024

"Threats to democracy," 14 November 2024, Government House, Sydney. (See the papers in the June 2025 issue.) https://www.youtube.com/playlist?list=PLYFFwCGj2FIZlvYa8S8dFlDottMW7nU6V

Southern Highlands Branch Meeting 2024-10

Vince Di Pietro AM CSC FRSN, "Community Resilience and National Readiness," 21 November 2024, RSL Mittagong, Carrington Room.

Launch and Inaugural Meeting of the New England North West Branch

Dr Amy Moss and Dr Marissa Betts, ARC DECRA Fellows, "Women in STEM," 25 November 2024, NOVA, 122 Faulkner Street, Armidale, and live stream. https://www.youtube.com/watch?v=jEe7w5vJJ_Q

1328th OGM, Open Lecture and Christmas Party

Scientia Professor Helen Christensen AO FASSA FAHMS, "Social media and smartphones for youth: What's the story?" 4 December 2024, Metcalfe Theatre, State Library of NSW. https://www.youtube.com/watch?v=T-l3MBJ26Bo

Note on Gazetting

The Government Gazette of the State of New South Wales is managed by the New South Wales Parliamentary Counsel's Office and has published Government notices, regulations, forms and orders since 1832. It went on line in 2001 and since 2014 is only to be found at https://legislation.nsw.gov.au/gazette.

Government Gazette

of the State of

New South Wales

Number 266 - Other

Friday, 12 July 2024

On the initiative of RSNSW Fellow Robert Whittaker AM FRSN, the Society approached His Excellency the Governor to formally gazette fellows of the Society. All current fellows were included in the first gazetting in 2018, and subsequently at the beginning of each year fellows elected in the previous year will appear in the Gazette.

As the Gazette of Friday 12 July 2024 says:

> "Her Excellency the Honourable Margaret Beazley AC KC, Governor of New South Wales, as Patron of The Royal Society of New South Wales and in furtherance of the aims of the Society in encouraging and rewarding the study and practice of Science, Art, Literature and Philosophy, is pleased to advise and acknowledge the election of the following as Fellows of the Society in 2023."

Fellows

Proven leaders and experts in their field, entitled to use the post nominal FRSN. Please note Professorial titles — including adjuncts, conjoint, and professors of practice — have been used where applicable. Details as to their field of expertise, their resident university (or universities) or institution may be ascertained from the Royal Society of New South Wales.

AMMIT, Professor Alaina Jean FRSN

ASHBURN, Professor Elizabeth Anne OAM FRSN

BERAN, Professor Roy Gary AM FRSN

BITSIKA, Professor Vicki F AM FRSN

BROPHY, Dr Joseph John FRSN

CAIN, Associate Professor Amy Katherine FRSN

COLAGIURI, Professor Ben FRSN

CONDON, Mr Andrew Thomas CSC FRSN

CONDREN, Professor Conal Stratford FRSN

COPELAND, Professor Les Les AM FRSN

CRIPPS, Professor Sally Ann FRSN

CROUCHER, Professor Rosalind Frances AM FRSN

DINGER, Professor Marcel Eduard FRSN

ETHERIDGE, Mr Lionel FRSN

GREENHILL, Professor Catherine FRSN

GRIFFITHS, Associate Professor Kalinda FRSN

GUO, Professor Yingjie Jay FRSN

HOLDEN, Professor Richard FRSN

KARTON, Professor Amir FRSN

LANGFORD, Professor Steven James FRSN

LI, Dr Jiao Jiao FRSN

LOVEGROVE, Professor Kim RML MSE (Ethiopia) FRSN

MALAU-ADULI, Professor Aduli Enoch Othniel FRSN

MAN, Professor Si Ming FRSN

MILLER, Mr Steven James FRSN

MILLER, Professor David Philip FRSN

MILLS, Professor Anthony John FRSN

NEWSON, Professor Ainsley FRSN

NI, Professor Bing-Jie FRSN

PAILTHORPE, Professor Bernard Alexander FRSN

PRASAD, Professor Deo Karan AO FRSN

RAMBURUTH, Professor Prem FRSN

REDDEL, Professor Roger Robert AO FRSN

REID, Professor Nicholas Charles H FRSN

RYAN, Professor Renae AM FRSN

SADLER, Professor Elaine Margaret AO FRSN

SCHULTZ, Professor Julianne AM FRSN

SHARPLEY, Professor Christopher F FRSN

SIMMONS, Professor Craig Trevor FRSN

TALLEY, Professor Nicholas Joseph AC FRSN

TEESSON, Professor Maree Rose AC FRSN

UPTON, The Hon Gabrielle Cecelia FRSN

UY, Professor Brian FRSN

WARD, Professor Christopher Morice FRSN

WATSON, Professor Stephanie Louise OAM FRSN

WILLIAMS, Dr Alan Nicholas FRSN

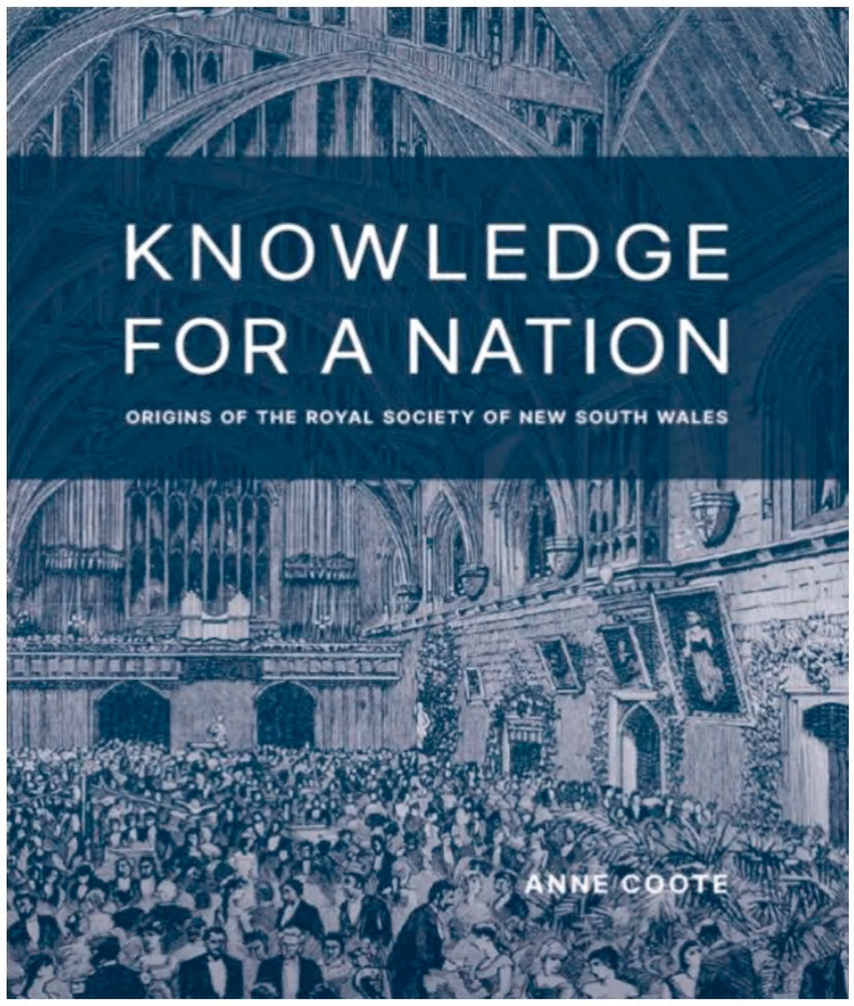
WILLIAMS, Dr Robyn AO FRSN

WOOD, Professor Robert Eric FRSN

Distinguished Fellows

Those Fellows of exceptional distinction, elected in 2020 by their peers, entitled to use the post nominal DistFRSN.

SLOAN, Professor Ian Hugh AO DistFRSN



The Governor: "this wonderful history,"

The State Librarian: "a crystal-clear and beautifully constructed exposition on the intellectual milieu, international parallels and the political machinations behind the creation and administration of the Royal Society. It helps inform not only the history of science in NSW, but more broadly the larger intellectual climate of Australia."

"a book which is genuinely engaging"

"the storytelling is compelling "

"takes the story outside the constrictions of Royal Society personalities, into the much more significant world of colonial society and politics"

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Knowledge for a Nation: Origins of the Royal Society of New South Wales by Anne Coote
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